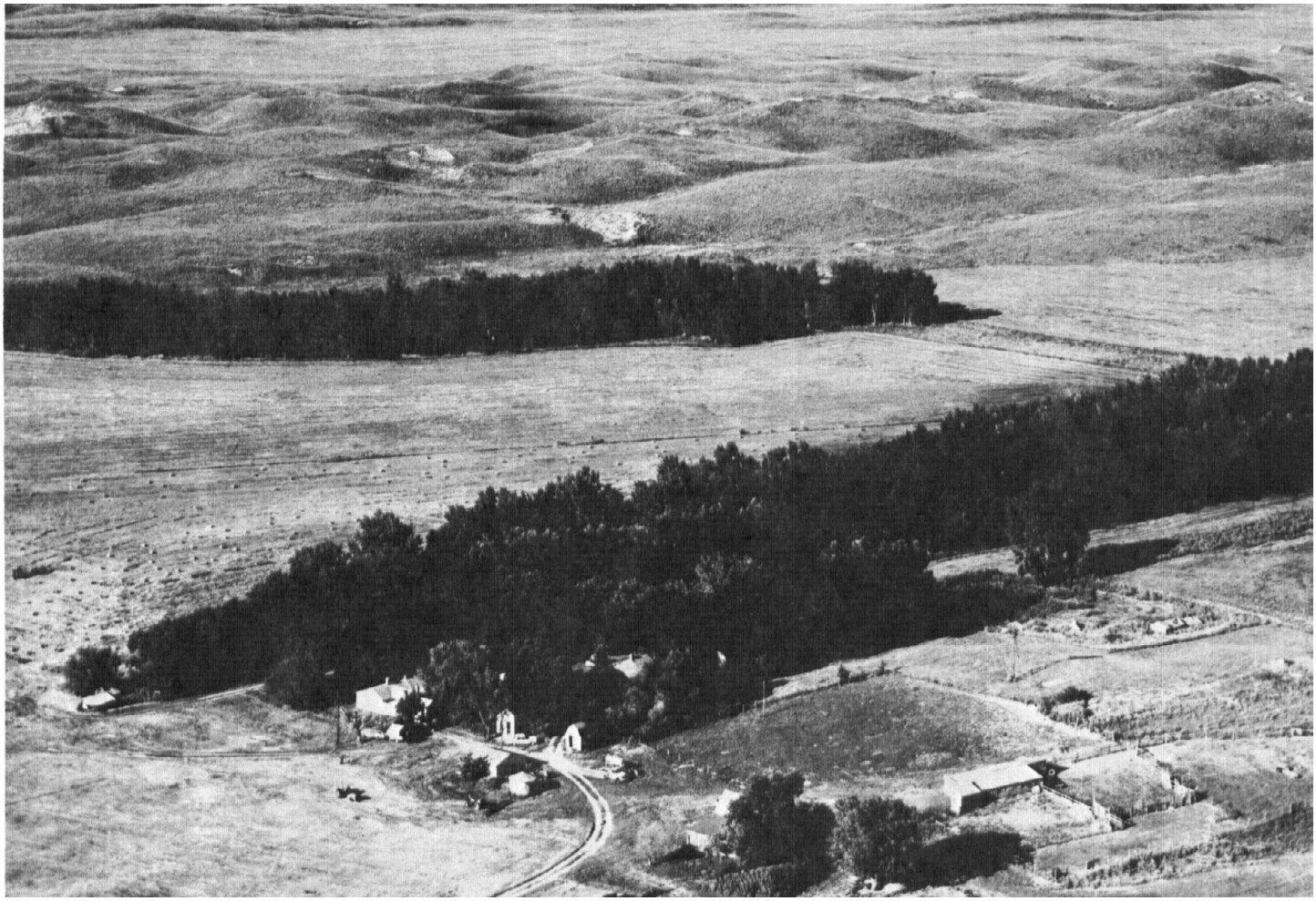
SOIL SURVEY OF

Logan County, Nebraska



United States Department of Agriculture
Soil Conservation Service
In cooperation with
University of Nebraska
Conservation and Survey Division

Issued December 1974

Major fieldwork for this soil survey was done in the period 1965–67. Soil names and descriptions were approved in 1969. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1968. This survey was made cooperatively by the Soil Conservation Service and the Conservation and Survey Division of the University of Nebraska. It is part of the technical assistance furnished to the Upper Loup Natural Resource District.

Enlarged or reduced copies of the soil map in this publication can be made by commercial photographers, or they can be purchased on individual order from the Cartographic Division, Soil Conservation Service, United States Department of Agriculture, Washington, D.C. 20250.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms, ranches, and woodlands; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of Logan County are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetic order by map symbol and gives the capability classification of each. It also shows the page where each soil is described and the page for the capability unit or units, range site, and windbreak suitability group in which the soil has been placed.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of the interpretive groupings.

Foresters and others can refer to the section, "Use of the Soils for Woodland and Windbreaks," where the soils of the county are grouped according to their suitability for trees.

Game managers, sportsmen, and others can find information about soils and wildlife in the section, "Use of the Soils for Wildlife and Recreation."

Ranchers and others can find, under "Use of the Soils for Range," groupings of the soils according to their suitability for range, and also the names of many of the plants that grow on each range site.

Engineers and builders can find, under "Engineering Uses of the Soils," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

Scientists and others can read about the formation and classification of soils in the section, "How the Soils of Logan County Were Formed, and How They Are Classified."

Newcomers in Logan County may be especially interested in the section, "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the county given in the section "Environmental Factors Affecting Soil Use."

Cover: **Typical sandhills ranch in Logan County. The background is part of the Valentine association, and the foreground is in the Valentine-Els association.**

Contents

Issued December 1974

SOIL SURVEY OF LOGAN COUNTY, NEBRASKA

BY MERRITT A. PLANTZ AND LESTER E. SHERFEY, SOIL CONSERVATION SERVICE [1]

UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH UNIVERSITY OF NEBRASKA, CONSERVATION AND SURVEY DIVISION

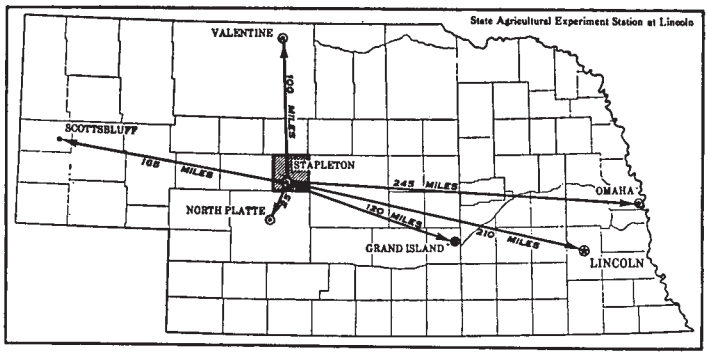


Figure 1.—**Location of Logan County in Nebraska.**

LOGAN COUNTY is along the southeastern edge of the Nebraska Sandhills (fig. 1). The total land area is about 570 square miles, or 364,608 acres. The county has a population of 991. Stapleton, the county seat and largest town, is in the south-central part of the county.

Farming and ranching are the main source of income in Logan County. The main kinds of specialization are cattle ranching, general livestock farming, and cash grain farming. About 86 percent of the acreage is in permanent grass, less than 14 percent is cultivated, and a small amount has been planted to trees for windbreaks. Large cattle ranches control most of the grassland. They raise both feeder cattle and purebred breeding stock. General livestock farms raise beef cattle, hogs, sheep, and dairy cattle. The sale of livestock products makes up about 80 percent of the farm and ranch income. The principal dryland crops are wheat, corn, and alfalfa. Corn and alfalfa are the main irrigated crops. Crop sales constitute about 20 percent of the farm and ranch income.

Soils in the northern three-fourths of the county formed in windblown (eolian) sand. This sand forms a series of rolling hills and valleys. The soils in some of the valleys are poorly drained.

Along the south side of the county is a tableland of wind-deposited silts (loess). Silty and loamy soils formed here. Drainage is incomplete, and there are many drainageways that end in potholes.

The land sloping north to the South Loup River is deeply dissected by drainageways. Windblown sands have been mixed with the silty loess material, and this has resulted in soils that range from sandy to silty. The South Loup River is not deeply entrenched in the western three-fourths of the county. The soils in the western part of the Loup Valley are mostly poorly drained.

Valentine soils, which make up over 75 percent of the county, are used mostly for range.

Nearly level to gently sloping soils, such as the Holdrege and Hord, make up about 6 percent of the county. These are the most intensively cultivated soils and are very important in the county. Erosion has been severe on some of the steeper cultivated soils.

Some of the coarse textured and moderately coarse textured soils, such as the Valentine, Dunday, and Hersh, are cultivated. These soils are subject to soil blowing if they are bare.

Some areas are irrigated with water from the Loup River and from deep wells. There is a potential for more development of deep-well irrigation.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Logan County, where they are located, and how they can be used. The soil scientists went into the county knowing they would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The soil series and the soil phase are the categories of soil classification most used in a local survey (*4*).[2]

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer,

[1] Other soil scientists who contributed to the field survey are LAURENCE E. BROWN, WILLIAM J. JONES, CHARLES C. COTTER, and GILBERT A. BOWMAN, Soil Conservation Service.

[2] Italic numerals in parentheses refer to Literature Cited, page 68.

all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Valentine and Loup, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Anselmo fine sandy loam, 0 to 3 percent slopes, is one of several phases within the Anselmo series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map in the back of this publication was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. Two such kinds of mapping units are shown on the soil map of Logan County—the soil complex and the undifferentiated group.

A soil complex consists of areas of two or more soils, so intermingled or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. The name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Uly-Coly silt loams, 15 to 31 percent slopes, is an example.

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. The name of an undifferentiated group consists of the names of the dominant soils, joined by "and." Hersh and Valentine soils, 5 to 11 percent slopes, is an example.

In most areas surveyed there are places where the soil material is so rocky, so shallow, or so severely eroded that it cannot be classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Blown-out land is a land type in Logan County.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soil in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil. Yields under defined management are estimated for all the soils.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in such a way as to be readily useful to different groups of users, among them farmers, managers of woodland and rangeland, and engineers.

On the basis of yield and practice tables and other data, the soil scientists set up trial groups. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others, then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Logan County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of farming or other land use. Such a map is not suitable for planning the management of a farm or field, because the soils in any one association ordinarily differ in slope, depth, drainage, or other characteristics that affect management. The eight soil associations in Logan County are described in the following paragraphs.

Unless stated otherwise, soil texture given in the descriptive heading for the soil associations refers to texture of the surface layer. Some association boundaries and names may not match adjoining areas in adjacent counties. This can result from changes in soil groupings or changes in correlation procedures.

1. Valentine association

Rolling and hilly, excessively drained, sandy soils on sandhills

This is the major soil association in the Sandhills part of the county. It is on rolling and hilly sand dunes. Slopes range from nearly level in the long narrow valleys and swales to steep on the higher dunes. The rolling dunes are smooth and only 20 to 50 feet high. The hilly dunes are rough and include catsteps and cup-shaped areas. They are 50 to 100 feet or more high. The dunes form long ridges that generally have an east-west or northwest-southeast orientation. This association has little or no

defined pattern of drainage because the rate of moisture infiltration is high.

This association occupies about 50 percent of the county. Valentine soils make up about 99 percent of the association, and minor soils, 1 percent (fig. 2).

Valentine soils have a surface layer of grayish-brown fine sand about 5 inches thick. The underlying material is pale-brown and very pale brown fine sand. Permeability is rapid.

The minor soils of this association are the Dunday, Els, and Elsmere soils. These are in swales and valleys. Dunday soils occupy the higher and drier parts of the valleys. Els and Elsmere soils are in lower areas where the water table is 2 to 6 feet below the surface.

The soils of this association are too sandy and the terrain is too rough for most cultivated crops. Little hay is grown, because the valleys are too narrow for much more than an occasional small meadow. Nearly all of this association is in native grass range. There is a hazard of the sandy soils blowing, even where they are in range, if the protective grass cover is damaged or destroyed.

The rough terrain makes range management difficult. It is hard to find good locations for wells and fences. Ranches are large, and both feeder and purebred cattle are marketed. Because of the lack of hay, however, only a few ranch headquarters are located in this association. As a consequence there are very few roads. Access trails generally follow along the valleys.

2. *Valentine-Dunday association*

Nearly level to rolling, excessively drained and somewhat excessively drained, sandy soils on sandhills and in valleys

This association is on rolling sand dunes and in the narrow to broad, intervening valleys. Slopes range from nearly level in the valleys to strongly sloping on the dunes. The dunes are 20 to 50 feet high and have a few small catsteps. The dunes and valleys have an east-west or northwest-southeast orientation. There is little or no defined pattern of drainage because the rate of moisture infiltration is high.

This association occupies about 19 percent of the county. Valentine soils make up about 87 percent of the association; Dunday soils, 10 percent; and minor soils, 3 percent.

Valentine soils are mostly on rolling dunes. The surface layer is about 5 inches thick. Generally, it is grayish-brown fine sand, but in valleys this layer is mostly loamy fine sand. The underlying material is pale-brown and very pale brown sand. Permeability is rapid.

Dunday soils are in valleys. They have a surface layer

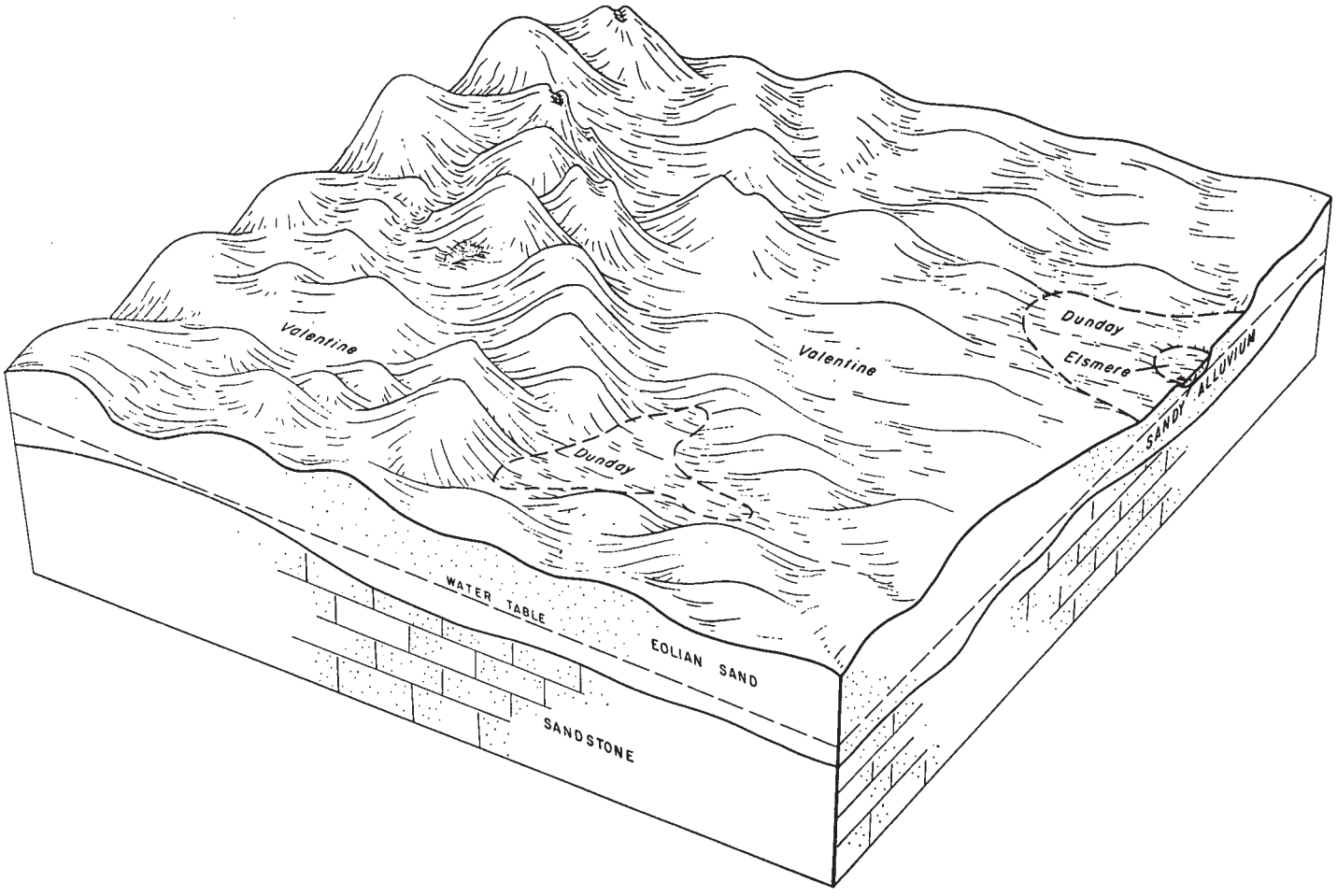


Figure 2.—Relationship of soils to topography and parent material in the Valentine association.

of dark-gray loamy fine sand, about 11 inches thick, and a transitional layer of pale-brown fine sand about 13 inches thick. The underlying material is very pale brown fine sand. Permeability is rapid.

The minor soils are the Els and Elsmere soils in the lower parts of valleys, where the water table is 2 to 6 feet below the surface, and the Hersh soils in well-drained, hummocky valleys.

This association is mainly used for range. Some areas are mowed for winter hay. Most of the soils in this association are too sandy and rolling for cultivated crops, although many areas in the valleys were dryfarmed at one time. Soil blowing, droughtiness, and low fertility caused most areas of these soils to be returned to grass; however, some valleys are now being developed for sprinkler irrigation. Ranches are large, and there are some improved roads and ranch headquarters in the larger valleys.

The main concerns of range management are preventing overgrazing, providing adequate winter feed for livestock, and establishing protective grasses in areas that were cultivated in the past.

3. *Valentine-Hersh association*

Nearly level to gently rolling, excessively drained to well-drained sandy and loamy soils on uplands and in valleys

This association is in nearly level to gently undulating upland valleys and on gently rolling dunes, in areas transitional from the Sandhills to the loess-covered hills and tablelands. The valleys are narrow and irregular. Dunes and hummocks are nearly all less than 20 feet high. Drainageways from the loessal hills cross some of these areas. Runoff is slow to medium.

This association occupies about 8 percent of the county. Valentine soils make up about 65 percent of the association; Hersh soils, 20 percent; and minor soils, 15 percent.

Valentine soils are nearly level to gently rolling. The surface layer is grayish-brown loamy fine sand about 5 inches thick. Next is a transitional layer of brown loamy fine sand about 12 inches thick. The underlying material is pale-brown to light-gray loamy fine sand and fine sand. Permeability is rapid.

Hersh soils are nearly level to gently rolling. The surface layer is dark grayish-brown fine sandy loam about 2 inches thick. Beneath this is a layer of grayish-brown fine sandy loam about 14 inches thick. The underlying material is light brownish-gray fine sandy loam in the upper part and grades to loamy fine sand in the lower part. Permeability is moderately rapid.

The minor soils are the Anselmo soils on uplands; the Hobbs, Vetal, and Ovina soils in valleys; and the Uly soils, Rough broken land, loess, and Coly soils on sides of some drainageways.

The main hazards in this association are soil blowing, droughtiness, and low fertility. Some abandoned fields should be seeded to grass. The association has large general livestock farms and cattle ranches. Some areas are farmed. Alfalfa, corn, and rye are fed on the farms. Wheat is the main cash crop. There is considerable potential for sprinkler irrigation. Gravel roads follow most section lines, improved dirt roads follow some section lines, and unimproved single-lane roads follow the rest.

4. *Ovina-Anselmo association*

Nearly level and very gently sloping, moderately well drained and well drained, loamy soils on stream terraces

This association is on nearly level to very gently sloping stream terraces along the South Loup River. These terraces are cut in many places by side drains from the bordering hills.

The association occupies about 2 percent of the county. Ovina and Anselmo soils each make up about 30 percent of the association, and minor soils, about 40 percent.

Ovina soils are nearly level to very gently sloping and have a plow layer of gray fine sandy loam. The next layer is dark-gray very fine sandy loam about 4 inches thick. Below this is a transitional layer of light brownish-gray fine sandy loam about 7 inches thick. The underlying material is light-gray fine sandy loam. Ovina soils have moderately rapid permeability. They are moderately well drained and have a water table 5 to 8 feet below the surface.

Anselmo soils are nearly level. The surface layer is dark grayish-brown fine sandy loam about 11 inches thick. The subsoil is typically grayish-brown fine sandy loam about 18 inches thick. The underlying material is stratified, pale-brown loamy fine sand and fine sandy loam. Anselmo soils are well drained. Permeability is moderately rapid.

The minor soils in this association are the Els and Elsmere soils on low-lying stream terraces, the Hersh soils on low, eroded hummocks, the Loup soils in narrow stream bottoms, and the Valentine soils on large hummocks and dunes.

Most of this association is used for cultivated crops. Many areas are irrigated with water from the South Loup River or from rather shallow wells. Small fields and irregular slopes hinder irrigation development. Some small areas are used for pasture, and several good windbreaks have been planted. Farms in the association are mostly general livestock units. The association is well served by roads, and much of it is traversed by the Stapleton branch of the Union Pacific Railroad.

Maintaining fertility and controlling soil blowing are the main management concerns if the soils are dryfarmed.

5. *Holdrege-Hord association*

Nearly level to strongly sloping, well-drained, silty soils on uplands

This association is on tablelands in the upland part of the county. Slopes range from nearly level to moderately sloping. Most of the surface runoff goes into small or large depressions.

This association occupies about 6 percent of the county. Holdrege soils make up about 48 percent of the association; Hord soils, 24 percent; Hobbs soils, 13 percent; and minor soils, 15 percent (fig. 3).

Holdrege soils are very gently sloping to strongly sloping and are on tablelands. They have a surface layer of silt loam about 13 inches thick. It is very dark grayish-brown in the upper part and dark grayish brown in the lower part. The subsoil is dark grayish-brown heavy silt loam in the upper part, grayish-brown light silty clay loam in the middle part, and pale-brown silt loam in the lower part. The underlying material is light-gray silt loam. Holdrege soils have moderate permeability.

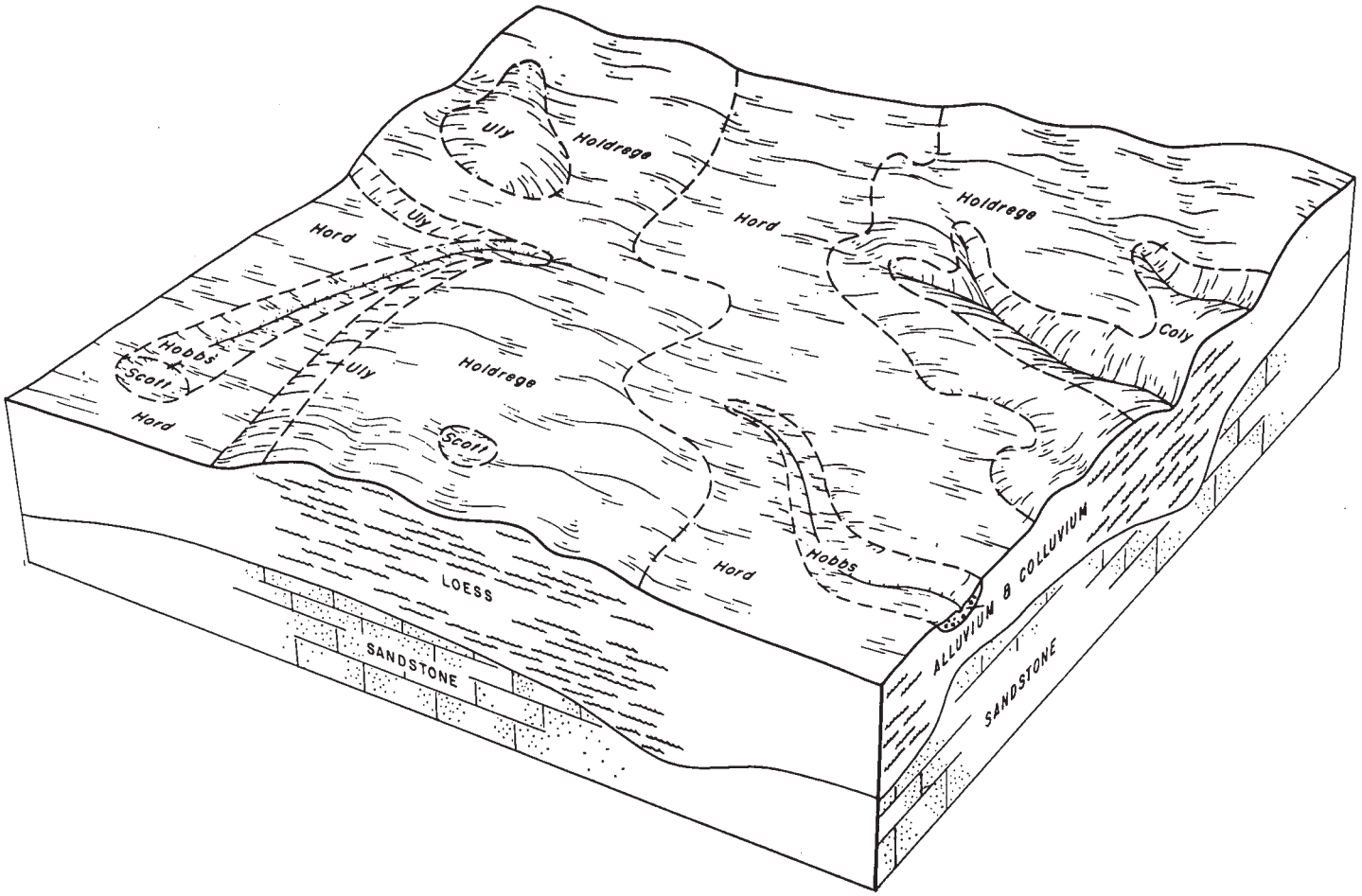


Figure 3.—**Relationship of soils to topography and parent material in the Holdrege-Hord association.**

Hord soils are nearly level to gently sloping and are in concave positions. They have a surface layer of dark grayish-brown and very dark grayish-brown silt loam about 20 inches thick. The subsoil is silt loam about 17 inches thick. It is dark grayish brown in the upper part and grayish brown in the lower part. The underlying material is brown loam. Permeability is moderate.

Hobbs soils are nearly level to very gently sloping. They are mainly in drainageways and around depressions in the uplands. They have a surface layer of silt loam about 22 inches thick. It is grayish brown in the upper part and dark grayish brown in the lower part. The underlying material is pale-brown silt loam. Below this is a dark, buried soil. Permeability is moderate.

The minor soils are the Coly and Uly soils on strongly sloping hillsides, the Hall soils in swales, the Hersh and Anselmo soils on hummocks, and the Scott soils in depressions.

Most areas of the soils in this association are cultivated. There are a few small areas of hay, pasture, and field windbreaks. This association makes up most of the wheat-fallow area of the county. In a few areas, crops are irrigated from deep wells. Wheat farming is the main enterprise. Most farms are used for growing grain and raising livestock. There is a potential for more irrigation development. Many farm headquarters are on this association, and there is an improved road on nearly every section line.

Water erosion on sloping fields and soil blowing on fallow fields are the main hazards.

6. *Uly-Hersh-Coly association*

Strongly sloping to steep, well-drained, silty and loamy soils on uplands

This association is on loess-covered hills and in canyons along drainageways that extend into the silty tablelands. There has been some overblowing and mixing of eolian sands.

This association occupies about 7 percent of the county. Uly soils make up about 35 percent of the association; Hersh soils, 25 percent; Coly soils, 15 percent; Rough broken land, loess, 15 percent; and minor soils, 10 percent.

Uly soils are strongly sloping and are on ridges. Typically, they have a surface layer of grayish-brown silt loam about 9 inches thick. The subsoil is friable silt loam about 11 inches thick. It is dark grayish brown in the upper part and grayish brown in the lower part. The underlying material is brown silt loam and very pale brown very fine sandy loam in the upper part, and it is light-gray very fine sandy loam in the lower part. Permeability is moderate.

Hersh soils are steep and occupy the sides of valleys and hills where sandy and silty materials have been mixed. Typically, they have a surface layer of dark grayish-brown fine sandy loam about 2 inches thick. Next is a transitional layer of grayish-brown fine sandy loam about 14 inches thick. The light brownish-gray underlying material is fine sandy loam in the upper part and loamy fine sand in the lower part. Permeability is moderately rapid.

Coly soils are on sharp ridges and the steep side slopes of drainageways. They have a surface layer of grayish-brown light silt loam about 3 inches thick. Beneath this is a transitional layer, about 6 inches thick, of light brownish-gray silt loam. The underlying material is calcareous, light-gray very fine sandy loam in the upper part and loamy fine sand in the lower part. Permeability is moderate.

Rough broken land, loess, is very steep silty material near the heads of deeply entrenched drainageways.

The minor soils are the Valentine, Hobbs, and Holdrege soils. Valentine soils are on hummocks near the base of slopes; Hobbs soils are in canyon bottoms; and Holdrege soils are on gently to moderately sloping ridgetops.

Soils in this association have rapid runoff because of the steepness of slopes. The hazard of water erosion is very severe if the grass cover is destroyed. Nearly all of the association is in grass that is used as pasture and range. The deep canyons provide winter protection for livestock and wild game. This association makes up part of small cattle ranches and large general grain and livestock farms, but there are very few roads or farm and ranch headquarters because the terrain is so rough.

7. *Gannett-Elsmere association*

Nearly level, poorly drained and somewhat poorly drained, sandy and loamy soils on bottom lands and stream terraces

This association consists of soils that formed in sandy and loamy alluvium along the South Loup River and some of its tributaries. It is on nearly level bottom lands and low-lying stream terraces.

This association occupies about 3 percent of the county. Gannett soils make up about 25 percent of the association; Elsmere soils, 12 percent; Marsh, Ord soils, and Wet alluvial land, 10 percent each; and minor soils, 33 percent.

In the Gannett soils, the upper part of the surface layer is dark-gray fine sandy loam about 6 inches thick. The lower part of this layer is very dark gray to gray fine sandy loam to clay loam. The underlying material, at a depth of about 23 inches, is light-gray fine sand. Gannett soils are poorly drained.

Elsmere soils are on low-lying stream terraces. They have a surface layer of dark-gray fine sand, about 11 inches thick, and a transitional layer of loose, light brownish-gray fine sand about 17 inches thick. The underlying material is gray loamy fine sand that is stratified with darker and finer textured layers. Elsmere soils are somewhat poorly drained. Permeability is rapid.

Marsh is a land type in low-lying and ponded areas. It is so wet that it produces only cattails and other aquatic plants.

Ord soils are somewhat poorly drained and have a surface layer of dark-gray fine sandy loam about 10 inches thick. Next is a layer of gray fine sandy loam about 13 inches thick. The underlying material is light-gray fine sand that is stratified with thin layers of darker and finer textured material. Permeability is moderately rapid.

Wet alluvial land is a land type that is similar to Marsh, but surface water drains off it well enough that water-tolerant grasses can grow. It is made up of alternate layers of organic matter, silt, and sand.

The minor soils are Loup soils on the bottoms; Anselmo, Dunday, Els, Hersh, and Ovina soils on stream terraces; and Valentine soils on low dunes and hummocks.

Most areas of the soils in this association are used as meadow. The association furnishes winter hay for many ranches, and there is a high potential for increasing hay production. A few small areas are cultivated, and some are pastured. The high water table makes roadbuilding difficult, however, and the association is undesirable for building sites. Drainage work has improved hay meadows but not wildlife habitat. There is a small potential for sprinkler irrigation.

8. *Valentine-Els association*

Nearly level to rolling, excessively drained and somewhat poorly drained, sandy soils on sandhills and in valleys

This association occurs in the valley of Wild Horse Creek and in several enclosed valleys in the Sandhills. It consists of nearly level depressions, bottom lands, and stream terraces and the intervening low dunes. Runoff is slow to very slow.

This association occupies about 5 percent of the county. Valentine soils make up about 45 percent of the association; Els soils, 35 percent; Elsmere soils, 10 percent; and minor soils, 10 percent.

Valentine soils are on valley floors and low dunes. These soils are nearly level to rolling and are excessively drained. Typically, they have a surface layer of grayish-brown fine sand about 5 inches thick. Next is a layer of brown fine sand about 4 inches thick. The underlying material is pale-brown and very pale brown fine sand.

Els soils are on valley floors and stream terraces. These soils are nearly level and very gently sloping. They have a grayish-brown fine sand surface layer about 7 inches thick. Next is about 7 inches of light brownish-gray fine sand. The underlying material is light-gray sand. Els soils are somewhat poorly drained.

Elsmere soils occur in slightly lower areas than Els soils and have a thicker and slightly darker surface layer. They are somewhat poorly drained.

Minor soils are the Anselmo, Dunday, and Hersh soils in higher parts of valleys and terraces, and the Tryon soils and Wet alluvial land in lower parts of valleys.

This association is mainly used for hay meadows or range. A few small areas have been cultivated. There is a possibility of developing some areas for sprinkler irrigation. A large amount of hay is cut for winter feed in this association, and the area contains the headquarters of many large ranches.

Descriptions of the Soils

In this section the soil series and the mapping units in Logan County are described in alphabetic order. The procedure is first to describe each soil series, and then the mapping units in that series. Thus, to get full information on any one mapping unit, it is necessary to read both the description of that unit and the description of the soil series to which it belongs.

Each soil series contains two descriptions of a representative soil profile. The first description is brief and in terms familiar to a layman. The second, detailed and in technical terms, is for scientists, engineers, and others who need to make thorough and precise studies of soils. If the profile for a given mapping unit differs from this representative profile, the differences are stated in the description of the mapping unit or they are apparent in the name of the mapping unit. Unless otherwise indicated, the colors given in the descriptions are those of a dry soil.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Blown-out land, for example, does not belong to a series, but nevertheless is listed in alphabetic order along with the soil series.

Following the name of each mapping unit is a symbol in parentheses that identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit or units, the range site, and the windbreak suitability group in which the mapping unit has been placed. The page on which each interpretive group is described can be found by referring to the "Guide to Mapping Units" at the back of this survey.

The acreage and proportionate extent of each mapping unit are shown in table 1. Laboratory data from samples taken in adjoining or nearby counties are available for some of the soil series in Logan County (7). Many of the terms used in describing soils can be found in the Glossary.

The names and boundaries of some soils are unlike those appearing in recently published surveys of adjacent counties. This is the result of changes in concepts of soil series in the application of the soil classification system. For some series, the profile selected as representative has one or more features outside the defined range of characteristics. In these instances, a reference is made to explain how the soil differs.

Anselmo Series

The Anselmo series consists of deep, well-drained, nearly level to moderately sloping soils on uplands and stream terraces. These soils formed in wind-worked mixed silts and sands.

In a representative profile the surface layer is about 11 inches of dark grayish-brown fine sandy loam. The very friable subsoil is grayish-brown fine sandy loam about 18 inches thick. The underlying material is pale-brown loamy fine sand that is stratified with lenses and layers of fine sandy loam.

Permeability is moderately rapid, and available water capacity is moderate. The organic-matter content is

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Soil	Area	Extent	Soil	Area	Extent
	Acres	*Percent*		*Acres*	*Percent*
Anselmo fine sandy loam, 0 to 3 percent slopes	3,000	0.8	Holdrege silt loam, 5 to 11 percent slopes	780	0.2
Anselmo fine sandy loam, 3 to 5 percent slopes	2,240	.6	Holdrege silt loam, 5 to 11 percent slopes, severely eroded	3,950	1.1
Anselmo fine sandy loam, 5 to 11 percent slopes	900	.2	Holdrege-Hord silt loams, 0 to 3 percent slopes	1,420	.4
Anselmo fine sandy loam, terrace, 0 to 1 percent slopes	1,450	.4	Hord silt loam, 0 to 1 percent slopes	473	.1
Blown-out land	220	.1	Hord silt loam, 1 to 3 percent slopes	3,950	1.1
Coly loam, 15 to 31 percent slopes	320	.1	Hord silt loam, 3 to 5 percent slopes	402	.1
Coly and Uly silt loams, 11 to 15 percent slopes	2,400	.6	Loup fine sandy loam	675	.2
Dunday-Valentine loamy fine sands, 0 to 3 percent slopes	6,500	1.8	Marsh	1,400	.4
Dunday-Valentine loamy fine sands, 3 to 9 percent slopes	460	.1	Ord fine sandy loam	1,100	.3
Els and Elsmere fine sands	10,090	2.8	Ord fine sandy loam, alkali	297	.1
Gannett fine sandy loam	3,200	.9	Ovina fine sandy loam	2,500	.7
Hall silt loam	470	.1	Rough broken land, loess	4,950	1.4
Hersh fine sandy loam, 3 to 5 percent slopes	3,700	1.0	Scott soils	460	.1
Hersh and Anselmo fine sandy loams, 0 to 3 percent slopes	1,900	.5	Tryon loamy fine sand	625	.2
Hersh and Valentine soils, 5 to 11 percent slopes	3,350	.9	Uly silt loam, 0 to 2 percent slopes	390	.1
Hersh and Valentine soils, 11 to 31 percent slopes	8,500	2.3	Uly-Coly silt loams, 15 to 31 percent slopes	7,350	2.0
Hobbs silt loam, 0 to 1 percent slopes	450	.1	Uly-Holdrege silt loams, 5 to 11 percent slopes	660	.2
Hobbs silt loam, 1 to 3 percent slopes	2,550	.7	Uly-Holdrege silt loams, 11 to 15 percent slopes	1,700	.5
Holdrege fine sandy loam, 2 to 4 percent slopes, overblown	530	.1	Valentine fine sand, nearly level	550	.2
Holdrege silt loam, 3 to 5 percent slopes	760	.2	Valentine fine sand, rolling	148,298	40.7
Holdrege silt loam, 3 to 5 percent slopes, eroded	5,600	1.5	Valentine fine sand, hilly	29,500	8.1
			Valentine loamy fine sand, nearly level	8,400	2.3
			Valentine loamy fine sand, rolling	10,500	2.9
			Valentine complex, hilly	73,296	20.1
			Vetal fine sandy loam	447	.1
			Wet alluvial land	1,700	.5
			Water area	245	.1
			Total	364,608	100.0

moderately low. Reaction in the surface layer is neutral, and natural fertility is medium.

Anselmo soils are suitable for cultivated crops. They also are suitable for growing trees in windbreaks, for wildlife habitat, and for recreation. The moderately sloping Anselmo soils are mostly in pasture or range.

Representative profile of Anselmo fine sandy loam, 0 to 3 percent slopes (in a cultivated field, 0.15 mile east and 150 feet north of the southwest corner of sec. 22, T. 17 N., R. 27 W.):

Ap—0 to 5 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, thick, platy structure parting to weak, fine, granular structure; soft, very friable; neutral; abrupt, smooth boundary.

A12—5 to 11 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, medium and coarse, subangular blocky structure parting to weak, fine, granular structure; soft, very friable; neutral; gradual, smooth boundary.

B—11 to 29 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak, coarse, prismatic structure parting to weak, medium, subangular blocky structure; soft, very friable; mildly alkaline; gradual, smooth boundary.

C—29 to 60 inches, pale-brown (10YR 6/3), stratified loamy fine sand and fine sandy loam, grayish brown (10YR 5/2) moist; weak, coarse, prismatic structure parting to single grained; soft, very friable; mildly alkaline.

The A horizon ranges from 7 to 19 inches in thickness and is grayish brown or dark grayish brown. The B horizon ranges from 6 to 20 inches in thickness and from grayish brown to pale brown in color. The C horizon is pale brown to light gray and is fine sandy loam to loamy fine sand. In a few places the B and C horizons contain sufficient lime to produce slight to strong effervescence when treated with acid. In many places there are brownish relic mottles in the B and C horizon. Buried, dark layers are present in some places.

Anselmo soils are associated with Hersh, Dunday, Ovina, and Vetal soils. They have a thicker and darker A horizon than Hersh soils. They have a finer textured A horizon than Dunday soils and have a B horizon that is lacking in those soils. Anselmo soils are better drained and deeper to lime than Ovina soils. They have a thinner A horizon than Vetal soils.

Anselmo fine sandy loam, 0 to 3 percent slopes (AnB).—This soil is in irregularly shaped areas in valleys and on uplands. These areas range from 5 to 60 acres in size. Slopes are concave to slightly undulating. A profile of this soil is described as representative for the Anselmo series.

Included with this soil in mapping are small areas of Hersh soils on low ridges. Some small areas have a silt loam surface layer. Also included are some Vetal soils in swales.

Soil blowing is the main hazard if this soil is cultivated. The maintenance of fertility is the main management concern if this soil is dryfarmed or irrigated. The content of nitrogen and phosphorus generally is deficient. Runoff is slow.

Nearly all of this soil is cultivated. Corn, wheat, and alfalfa are the main crops. Capability units IIIe–3, dryland, and IIe–31, irrigated; Sandy range site; Sandy windbreak suitability group.

Anselmo fine sandy loam, 3 to 5 percent slopes (AnC).—This soil is in irregularly shaped areas on the uplands. Areas range from 3 to 40 acres in size. The soil profile is similar to that described as representative of the series, except that the surface layer and subsoil are slightly thinner (fig. 4).

Included with this soil in mapping are small areas of Anselmo soils that have slopes of 1 to 3 percent or of 5 to 11 percent. Some included areas have a surface layer of silt loam. Also included are small areas of Dunday and Holdrege soils.

Water erosion and soil blowing are hazards if this soil is cultivated. Maintaining fertility is a concern if the soil is dryfarmed or irrigated. Nitrogen and phosphorus generally are deficient. Runoff is slow to medium.

About half the acreage of this soil is in cultivated crops, of which alfalfa, corn, and wheat are the most important. This soil is well suited to grass. Capability units IIIe–31, dryland, and IIIe–3, irrigated; Sandy range site; Sandy windbreak suitability group.

Anselmo fine sandy loam, 5 to 11 percent slopes (AnD).—This soil is in irregularly shaped areas of uplands. The areas range from 3 to 40 acres in size. The profile of this soil has a slightly thinner surface layer and subsoil, but otherwise it is similar to the one described as representative of the series.

Included in mapping are small areas of Hersh soils on

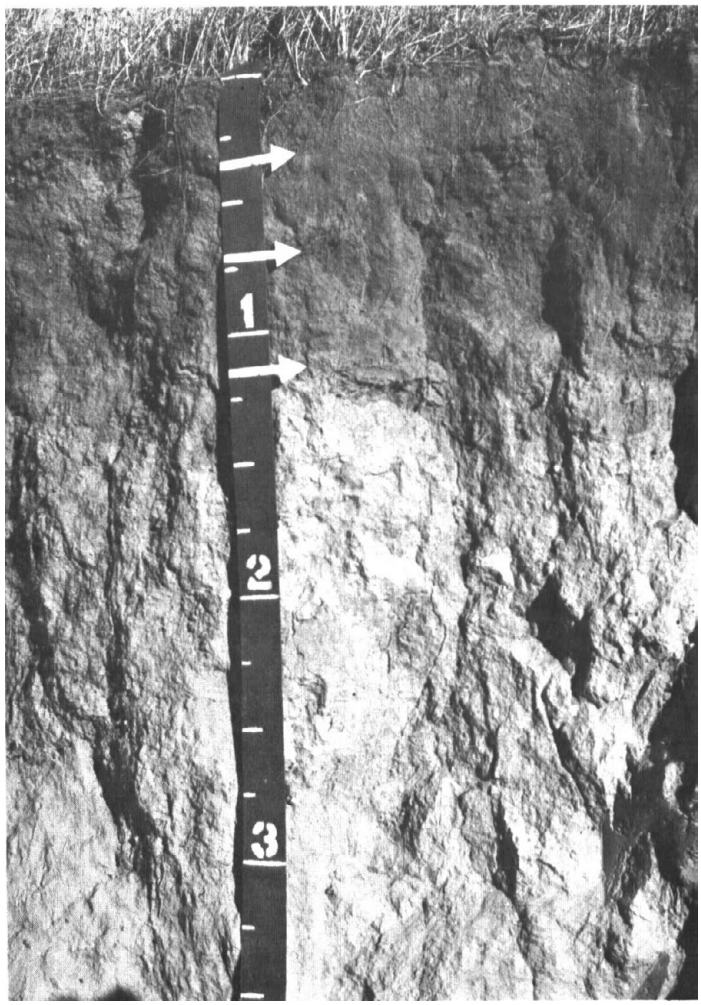


Figure 4.—**Profile of an Anselmo fine sandy loam showing plow layer, lower part of surface layer, subsoil, and underlying material.**

ridges or upper parts of slopes. In a few places narrow strips of Hobbs soils are included along drainageways or in swales.

Water erosion and soil blowing are hazards if this soil is cultivated. Maintenance of fertility is a concern if the soil is dryfarmed or irrigated. Nitrogen and phosphorus generally are deficient. Runoff is medium.

About one-third of the acreage of this soil is cultivated, and the rest is in native grass. Capability units IVe–3, dryland, and IVe–3, irrigated; Sandy range site; Sandy windbreak suitability group.

Anselmo fine sandy loam, terrace, 0 to 1 percent slopes (AtA).—This soil is on stream terraces. Areas are elongated and range from 5 to 80 acres in size. The profile of this soil is similar to that described as representative of the series, except that stains in the lower part of the profile are common.

Included with this soil in mapping are small areas of gently undulating Anselmo soils and Ovina soils. Also included are areas where the surface layer is loamy fine sand.

Soil blowing is the main hazard if this soil is cultivated. Nitrogen and phosphorus generally are deficient. Runoff is slow.

Nearly all of this soil is cultivated, and most of it is irrigated. Corn and alfalfa are the main crops. Capability units IIe–3, dryland, and IIe–3, irrigated; Sandy range site; Sandy windbreak suitability group.

Blown-Out Land

Blown-out land (3 to 100 percent slopes) (Bo) forms in areas where the protective plant cover has been destroyed by cattle trails, by a concentration of livestock, or by cultivation. Blown-out land consists of wind-eroded areas where wind action has removed the sandy soil, deposited it in adjacent areas, and thus smothered the vegetation and created an ever-enlarging area that is subject to soil blowing.

The soil material of Blown-out land is light-gray fine sand. In some places layers of pale-brown loamy fine sand are exposed on the bottom of the blowouts. Blowouts that are only 2 to 5 acres in size are shown on the soil map by a special symbol.

After soil blowing starts, it spreads by undercutting, sand blasting, or burying the plants. Soil blowing continues until vegetation is reestablished in the area. Most areas of Blown-out land consist of bowllike depressions and the adjacent overblown areas. The depressions range from 3 to 20 feet in depth. In some places vegetation has stabilized previously overblown areas.

Areas of Blown-out land have little or no practical use until vegetation is reestablished. Capability unit VIIe–5, dryland; Sands range site; Very Sandy windbreak suitability group.

Coly Series

The Coly series consists of deep, strongly sloping to steep, well-drained soils on uplands. These soils formed in loess.

In a representative profile the surface layer is grayish-brown light silt loam about 3 inches thick. Beneath this is a transitional layer of light brownish-gray light silt loam about 6 inches thick. The upper part of the underlying material is light-gray very fine sandy loam, and the lower part is loamy fine sand. The soil is calcareous at a depth of about 9 inches.

Permeability is moderate, and available water capacity is high. Natural fertility is medium, and organic-matter content is low.

Coly soils are used mainly for range. They are also suitable for windbreak plantings, recreation, and wildlife habitat. Coly soils are too steep and the hazard of erosion is too severe for cultivated crops.

Representative profile of Coly silt loam in an area of Uly-Coly silt loams, 15 to 31 percent slopes (in native range, 100 feet north and 300 feet west of the center of sec. 11, T. 17 N., R. 26 W.):

A—0 to 3 inches, grayish-brown (10YR 5/2) light silt loam, very dark grayish brown (10YR 3/2) moist; weak, fine, granular structure; slightly hard, very friable; mildly alkaline; clear, smooth boundary.

AC—3 to 9 inches, light brownish-gray (10YR 6/2) light silt loam, dark grayish brown (10YR 4/2) moist; moderate, coarse, prismatic structure parting to weak, medium, subangular blocky structure; hard, very friable; mildly alkaline; gradual, wavy boundary.

C1ca—9 to 42 inches, light-gray (10YR 7/2) very fine sandy loam, grayish brown (10YR 5/2) moist; weak, coarse, prismatic structure; slightly hard, very friable; moderately alkaline; violent effervescence; gradual, wavy boundary.

IIC2—42 to 60 inches, light-gray (10YR 7/2) loamy fine sand, grayish brown (10YR 5/2) moist; single grained; soft, loose; moderately alkaline; strong effervescence.

The A horizon ranges from 2 to 6 inches in thickness and is neutral to moderately alkaline. It is dark grayish brown to light gray and has a loam or silt loam texture. Part or all of the AC horizon is in the plow layer in some cultivated areas. The C horizon ranges from very fine sandy loam to silt loam in the upper part and from loamy fine sand to silt loam in the lower part. The depth to carbonates ranges from 0 to 10 inches.

In Logan County the clay content of the 10- to 40-inch layer averages less than is allowed in the defined range for the series, but this difference does not alter the usefulness and behavior of these soils.

Coly soils are associated with Hersh soils, Rough broken land, loess, and Uly soils. They contain less sand and more lime than Hersh soils. Coly soils have smoother slopes and more soil development than Rough broken land, loess. They have a thinner A horizon than Uly soils, are not so deep to lime as those soils, and lack a B horizon.

Coly loam, 15 to 31 percent slopes (CoG).—This soil is on eroded uplands. The areas are on divides and side slopes of drainageways. They range from 20 to 100 acres in size. The lower parts of the slopes are not so eroded as the upper parts. This soil has a profile similar to that described as representative of the series, except that it has a lighter colored surface layer of loam and has lime nearer to the surface.

Included with this soil in mapping are areas of soils that have a surface layer of silt loam and very fine sandy loam. Also included are some small areas of Uly soils on the lower slopes.

The use of this soil is severely limited by its steep slopes. The hazard of water erosion is too great for safe cultivation. Surface runoff is rapid.

All the acreage of this soil was cultivated in years past. Most of it has been returned to permanent grass and is used for pasture that generally is in poor condition.

Capability unit VIe–8, dryland; Limy Upland range site; Silty to Clayey windbreak suitability group.

Coly and Uly silt loams, 11 to 15 percent slopes (CuF).—This undifferentiated soil group consists of severely eroded soils on uplands. These soils are on the sides of drainageways and on narrow divides. Areas range from 10 to 200 acres in size. Some areas are made up entirely of Coly silt loam, and other areas entirely of Uly silt loam. Most areas, however, contain some of both soils. The Coly soil is lighter colored and has a thinner surface layer than the Uly soil. The Coly and Uly soils in this mapping unit have profiles similar to those described for their series, except that the surface layer is thinner and lighter colored.

Included in mapping are small areas of Hobbs, Holdrege, and Hord silt loams. These soils have the more gentle, lower slopes. Sand crops out in small areas on some ridges.

Runoff is rapid, and the hazard of water erosion is severe if the soils in this mapping unit are cultivated. Nitrogen and phosphorus contents generally are deficient.

Most areas of these soils are in pasture or range. Some small areas are cultivated. Capability unit VIe–8, dryland; the Coly soil is in the Limy Upland range site, and the Uly soil is in the Silty range site; Silty to Clayey windbreak suitability group.

Dunday Series

The Dunday series consists of deep, nearly level to moderately sloping, somewhat excessively drained soils on stream terraces and in dry upland valleys (fig. 5). These soils formed in windblown sands.

In a representative profile the surface layer is dark-gray loamy fine sand about 11 inches thick. Next is a transitional layer of pale-brown fine sand about 13 inches thick. The underlying material is pale-brown fine sand that extends to a depth of 60 inches or more.

Permeability is rapid. Available water capacity and natural fertility are low, and organic-matter content is moderately low. Reaction of the surface layer is slightly acid.

Dunday soils are better suited to grass than to most other plants. Many areas that were once cultivated have been seeded to grass or legumes. Some areas are sprinkler irrigated. These soils are suited to trees in windbreaks, limited recreation, and wildlife habitat.

Representative profile of Dunday loamy fine sand in an area of Dunday-Valentine loamy fine sands, 0 to 3 percent slopes (in native range, 0.25 mile north and 0.2 mile east of the southwest corner of sec. 36, T. 20 N., R. 28 W.):

A—0 to 11 inches, dark-gray (10YR 4/1) loamy fine sand, very dark brown (10YR 2/2) moist; weak, coarse, subangular blocky structure parting to weak, fine, granular structure; soft, very friable; slightly acid; clear, smooth boundary.

AC—11 to 24 inches, pale-brown (10YR 6/3) fine sand, grayish brown (10YR 5/2) moist; weak, coarse, subangular blocky structure parting to single grained; soft, very friable; neutral; gradual, smooth boundary.

C—24 to 60 inches, very pale brown (10YR 7/3) fine sand, light brownish gray (10YR 6/2) moist; common, coarse, distinct, brown (10YR 5/3) mottles; single grained; loose; neutral.

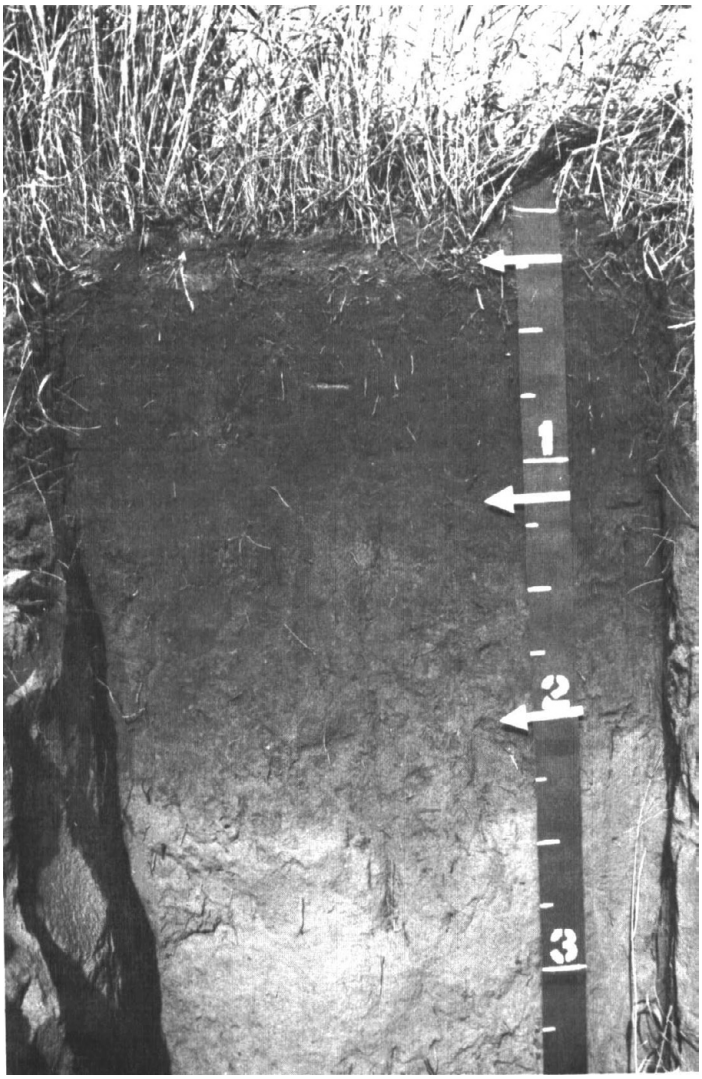


Figure 5.—**Profile of a Dunday soil. This coarse-textured soil formed in wind-deposited material.**

The A horizon ranges from 10 to 14 inches in thickness. In many cultivated areas, the plow layer is winnowed and has lost much of its silt, clay, organic matter, and structure. The texture of the AC and C horizons is loamy fine sand to fine sand. In some profiles the C horizon contains a thin layer of fine sandy loam.

Dunday soils are associated with Els, Elsmere, Hersh, and Valentine soils. Dunday soils have a lower water table than Els and Elsmere soils. They have a thicker A horizon than Els, Hersh, and Valentine soils. They have a thicker A horizon and are coarser textured above a depth of 40 inches than Hersh soils.

Dunday-Valentine loamy fine sands, 0 to 3 percent slopes (DvB).—This complex occurs on stream terraces and in upland valleys. About 50 percent of it is Dunday loamy fine sand, and 50 percent is Valentine loamy fine sand. Dunday loamy fine sand has a thicker and darker colored surface layer than Valentine loamy fine sand. The Dunday soil is in the swales, and the Valentine soil is at the higher elevations or on hummocks. Areas range from 20 to 300 acres in size.

The Dunday soil in this complex has the profile de-

scribed as representative of the series. The Valentine soil has a profile similar to that described as representative of the series, except that it has a loamy fine sand surface layer.

Included with these soils in mapping are small areas of Valentine fine sand. Small wet areas of Elsmere and Loup soils also are included.

Soils in this complex have severe limitations if they are cultivated because of the hazard of soil blowing, low available water capacity, and low fertility. Phosphorus and lime generally are deficient for legumes, and phosphorus and nitrogen for other crops. Runoff is very slow.

Alfalfa, corn, and rye are the main crops where the soils are dryfarmed. Corn and alfalfa are the main crops grown under sprinkler irrigation. Many areas are still in native range. Capability units IVe–5, dryland, and IVe–5, irrigated; Sandy range site; Sandy windbreak suitability group.

Dunday-Valentine loamy fine sands, 3 to 9 percent slopes (DvD).—This complex occurs along the edges of upland valleys. About 50 percent of the mapping unit is Dunday loamy fine sand, and 50 percent is Valentine loamy fine sand. Dunday loamy fine sand has a thicker and darker surface layer than Valentine loamy fine sand and is in lower positions. Areas range from 20 to 100 acres in size.

The Dunday soil in this complex has a profile similar to that described as representative of the series. The Valentine soil in this complex has a profile similar to that described as representative of the series, except for its surface layer of loamy fine sand.

Included in mapping are small areas of Dunday loamy fine sand, 0 to 3 percent slopes, and Valentine fine sand, rolling.

Soils in this mapping unit are not suited to cultivated crops, because of the severe hazards of soil blowing and water erosion. Runoff is slow.

This complex is mainly used for range. Some areas have been cultivated. Most of these cultivated areas have been returned to grass, but a few remain in alfalfa. Capability unit VIe–5, dryland; Sands range site; Very Sandy windbreak suitability group.

Els Series

The Els series consists of deep, nearly level to very gently sloping, somewhat poorly drained soils (fig. 6). The water table is generally at a depth of 3 to 6 feet, but it can be higher in wet seasons or lower in dry seasons. These soils are on bottom lands of upland valleys. They formed in mixed eolian and alluvial sandy materials.

In a representative profile the surface layer is grayish-brown fine sand about 7 inches thick. It is underlain by about 7 inches of loose, light brownish-gray fine sand. The underlying material is light-gray fine sand. Light yellowish-brown mottles are generally present in the underlying material.

Permeability is rapid, and available water capacity is low. Natural fertility and organic matter content are low.

Most areas of Els soils are used for range or hayland. These areas contain a few windbreaks. The soils also are suitable for recreation and for wildlife habitat.

Representative profile of Els fine sand in an area of Els and Elsmere fine sands (0.25 mile east and 100 feet north of the center of sec. 17, T. 20 N., R. 26 W.):

Figure 6.—**Profile of an Els soil. This somewhat poorly drained soil is used mainly for hay.**

A—0 to 7 inches, grayish-brown (10YR 5/2) fine sand, very dark grayish brown (10YR 3/2) moist; weak, medium, granular structure parting to single grained; soft, very friable; neutral; gradual, smooth boundary.

AC—7 to 14 inches, light brownish-gray (10YR 6/2) fine sand, dark grayish brown (10YR 4/2) moist; weak, fine, prismatic structure parting to single grained; soft, loose; neutral; clear, wavy boundary.

C—14 to 60 inches, light-gray (10YR 7/2) fine sand, light brownish gray (10YR 6/2) moist; few, distinct, fine, light yellowish-brown (10YR 6/4) mottles; single grained; soft, loose; mildly alkaline.

The A horizon ranges from 3 to 10 inches in thickness and from dark gray to light brownish gray in color. Reaction is neutral to mildly alkaline. The AC horizon ranges from 2 to 9 inches in thickness. The AC and C horizons are loamy fine sand to fine sand. In places there are buried horizons of very dark gray to grayish-brown fine sandy loam in the C horizon.

Els soils are associated with Elsmere, Tryon, and Valentine soils. They have a thinner A horizon than Elsmere soils. Els soils are not so poorly drained as Tryon soils. They are not so well drained as Valentine soils.

Els and Elsmere fine sands (0 to 3 percent slopes) (Ee).—This undifferentiated group occupies irregularly shaped areas in some of the low parts of enclosed valleys and on bottom lands of stream valleys. Areas range from 15 to 600 acres in size. Some areas of the mapping unit consist entirely of Els fine sand, and others are made up entirely of Elsmere fine sand. Most areas, however, contain both soils. The Els soil has a thinner surface layer than the Elsmere soil.

Included with these soils in mapping are small areas of soils that are strongly alkaline or poorly drained. Also, there are areas where the surface layer is loamy fine sand. Also included are small areas of Valentine, Loup, and Tryon soils and Wet alluvial land.

Soils in this mapping unit are too wet for cultivation during the wettest seasons. During dry parts of the year, the water table can be beneficial to grasses and growing crops. If cultivated, the soils are subject to a severe hazard of soil blowing unless they are protected by vegetation. Runoff is very slow.

Nearly all areas of these soils are used for hayland or range. Many meadows have been overseeded with alfalfa, clover, and tame grasses. A few areas are in nearly pure stands of alfalfa. These soils are suitable for irrigation but need a high level of management. Capability units VIw–5, dryland, and IVw–5, irrigated; Subirrigated range site; Moderately Wet windbreak suitability group.

Elsmere Series

The Elsmere series consists of deep, nearly level to very gently sloping, somewhat poorly drained soils. These soils formed in mixed eolian and alluvial sandy material on bottom lands and stream terraces. Depth to the water table ranges from 2 to 6 feet.

In a representative profile the surface layer is dark-gray fine sand about 11 inches thick. Next is a transitional layer of loose, light brownish-gray fine sand about 17 inches thick. The underlying material is gray loamy fine sand. At a depth of about 40 inches is a layer of very dark gray silt loam. Beneath this, at a depth of about 49 inches, is light brownish-gray fine sandy loam.

Permeability is rapid, and available water capacity is moderate to low. Reaction in the surface layer is mildly alkaline. Natural fertility is low, and organic-matter content is moderately low. Runoff is very slow.

Most areas of Elsmere soils are used for hay or for range. Also, a few windbreaks have been planted. The soils are suitable for wildlife habitat and for recreational uses.

In Logan County these soils are mapped only with Els soils as part of an undifferentiated group.

Representative profile of Elsmere fine sand in an area of Els and Elsmere fine sands (in a pasture, 0.1 mile south and 0.1 mile west of the center of sec. 34, T. 19 N., R. 27 W.):

A11—0 to 3 inches, dark-gray (10YR 4/1) fine sand, very dark grayish brown (10YR 3/2) moist; weak, coarse, granular structure; soft, very friable; strong effervescence; mildly alkaline; clear, wavy boundary.

A12—3 to 11 inches, dark-gray (10YR 4/1) fine sand, very dark grayish brown (10YR 3/2) moist; few, small, distinct, light yellowish-brown (10YR 6/4) mottles; weak, coarse, prismatic structure; soft, very friable; mildly alkaline; gradual, wavy boundary.

AC—11 to 28 inches, light brownish-gray (10YR 6/2) fine sand; grayish brown (10YR 5/2) moist; many, medium, distinct, light yellowish-brown (10YR 6/4) mottles; single grained; soft, loose; neutral; abrupt, smooth boundary.

C—28 to 40 inches, gray (10YR 6/1) loamy fine sand, grayish brown (10YR 5/2) moist; many, medium, distinct, light yellowish-brown (10YR 6/4) mottles; single grained; slightly hard, very friable; neutral; abrupt, wavy boundary.

IIAb—40 to 49 inches, very dark gray (10YR 3/1) silt loam, black (10YR 2/1) moist; massive; hard, friable; neutral; clear, smooth boundary.

IIACb—49 to 60 inches, light brownish-gray (10YR 6/2) fine sandy loam, dark gray (10YR 4/1) moist; massive; soft, friable; neutral.

The A horizon ranges from 10 to 16 inches in thickness and from dark gray to grayish brown in color. The AC horizon ranges from 6 to 18 inches in thickness. The AC and C horizons are loamy fine sand to fine sand. The depth to buried soil profiles ranges from 18 to more than 60 inches.

Elsmere soils are associated with Els, Gannett, Loup, and Tryon soils. They have a thicker A horizon than Els and Tryon soils. Elsmere soils are not so poorly drained as Gannett, Loup, and Tryon soils.

Gannett Series

The Gannett series consists of deep, nearly level, poorly drained soils that formed mainly in alluvium on bottom lands of stream valleys. A few areas of these soils are in Sandhill depressions. The water table ranges from the surface to a depth of 3 feet but is commonly at a depth of 12 to 30 inches.

In a representative profile there is about 1 inch of partially decomposed organic matter on the surface. The upper part of the surface layer is dark-gray fine sandy loam about 6 inches thick. The lower part is friable, very dark gray loam about 17 inches thick. The underlying material is light-gray fine sand that contains brownish-yellow mottles in the upper part.

Permeability is moderate in the surface layer and rapid in the underlying material. The available water capacity is moderate. Gannett soils have medium natural fertility and are high in organic-matter content.

Gannett soils are not suitable for cropping. They are better suited to use as hay meadows, and they are suited to development for wildlife habitat. Certain species of trees are suitable for use in windbreaks on these soils.

Representative profile of Gannett fine sandy loam (in a meadow, 0.3 mile west of the northeast corner of sec. 34, T. 18 N., R. 27 W.):

O—1 inch to 0, partially decomposed organic matter; strong effervescence.

A11—0 to 6 inches, dark-gray (10YR 4/1) fine sandy loam, very dark gray (10YR 3/1) moist; moderate, fine, granular structure; soft, very friable; strong effervescence; moderately alkaline; clear, wavy boundary.

A12—6 to 23 inches, very dark gray (10YR 3/1) loam, black (10YR 2/1) moist; moderate, coarse, blocky structure; slightly hard, friable; mildly alkaline; diffuse, smooth boundary.

C—23 to 60 inches, light-gray (2.5Y 7/1) fine sand, gray (2.5Y 6/1) moist; few, large, distinct, yellowish-brown (10YR 5/4) mottles in upper 15 inches; single grained; loose; mildly alkaline.

The A horizon ranges from 12 to 24 inches in thickness. The A12 horizon ranges from fine sandy loam to clay loam in texture. Reaction ranges from mildly to moderately alkaline in the A horizon. The AC horizon ranges from 2 to 6 inches in thickness and from light gray to dark gray in color. Some profiles have buried horizons in the C horizon.

Gannett soils are associated with Elsmere, Loup, and Ord soils and Wet alluvial land. Gannett soils are more poorly drained than Elsmere and Ord soils. They are finer textured than Elsmere soils. They are deeper to fine sand than Loup soils and are not so coarse textured as those soils. Gannett soils have a lower water table than Wet alluvial land.

Gannett fine sandy loam (0 to 1 percent slopes) (Ga).—This soil is in narrow to broad strips on bottom lands of the South Loup River and its tributaries. Areas range from 10 to 200 acres in size.

Included with this soil in mapping are small spots of alkali and spots of Marsh. Also included are small areas of Elsmere fine sand, Loup fine sandy loam, Ord fine sandy loam, and Wet alluvial land.

Surface ponding causes flooding during rapid snowmelt and after heavy rains. The high water table limits use of this soil to plants that can tolerate wetness. Drainage is seldom practical. Phosphorus generally is needed for legumes that are planted in meadows.

This soil is used mostly for hay meadows. A few small areas are used for range. This soil is too wet for cultivation. Capability unit Vw–3, dryland; Subirrigated range site; Very Wet windbreak suitability group.

Hall Series

The Hall series consists of deep, well-drained, nearly level soils. These soils formed in loess on uplands.

In a representative profile the upper part of the surface layer is gray silt loam about 6 inches thick. The lower part is dark-gray silt loam about 16 inches thick. The subsoil is grayish-brown, friable light silty clay loam in the upper 4 inches; grayish-brown, firm silty clay loam in the middle 10 inches; and pale-brown silt loam in the lower 6 inches. The underlying material is light-gray very fine sandy loam.

Permeability is moderately slow, and available water capacity is high. Fertility is high, and organic-matter content is moderate.

Hall soils are suitable for both dryland and irrigated crops and for range, windbreak plantings, wildlife habitat, and development for recreation.

Representative profile of Hall silt loam (in a cultivated field, 150 feet east and 0.3 mile north of the southwest corner of sec. 30, T. 17 N., R. 27 W.):

Ap—0 to 6 inches, gray (10YR 5/1) silt loam, very dark brown (10YR 2/2) moist; weak, fine, granular structure; slightly hard, very friable; slightly acid; abrupt, smooth boundary.

A12—6 to 11 inches, dark-gray (10YR 4/1) silt loam, very dark gray (10YR 3/1) moist; weak, thick, platy structure parting to weak, medium, granular structure; slightly hard, very friable; neutral; clear, smooth boundary.

A13—11 to 22 inches, dark-gray (10YR 4/1) silt loam, very dark brown (10YR 2/2) moist; weak, coarse, prismatic structure parting to weak, medium, granular structure; hard, friable; neutral; clear, smooth boundary.

B1—22 to 26 inches, grayish-brown (10YR 5/2) light silty clay loam, very dark grayish brown (10YR 3/2) moist; weak, medium, subangular blocky structure; hard, friable; neutral; clear, smooth boundary.

B2t—26 to 36 inches, grayish-brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; weak, coarse, prismatic structure parting to moderate, medium, subangular blocky structure; hard, firm; neutral; gradual, smooth boundary.

B3—36 to 42 inches, pale-brown (10YR 6/3) silt loam, grayish brown (10YR 5/2) moist; weak, coarse, prismatic structure parting to weak, medium, subangular blocky structure; hard, friable; neutral; gradual, smooth boundary.

C—42 to 60 inches, light-gray (10YR 7/2) very fine sandy loam, brown (10YR 5/3) moist; massive; soft, very friable; mildly alkaline.

The solum ranges from 30 to 54 inches in thickness. The A horizon ranges from 16 to 30 inches in thickness and is neutral or slightly acid in reaction. The B horizon ranges from 28 to 34 percent in clay content. The C horizon is very fine sandy loam to silt loam.

Hall soils are associated with Hobbs, Holdrege, Hord, and Scott soils. They are dark to a greater depth than Holdrege soils, and they have more clay in the B horizon than Hord soils. They have a B horizon that is lacking in the Hobbs soils. Hall soils have less clay in the B horizon and better surface drainage than Scott soils.

Hall silt loam (0 to 1 percent slopes) (Ha).—This soil is in swales on the loess-covered tablelands. Areas range from 20 to 300 acres in size. Included in mapping are small areas of Hobbs, Holdrege, Hord, and Scott soils.

If this soil is dryfarmed, there is a shortage of moisture for crops during most years. The hazard of erosion is slight. Runoff is slow.

Nearly all of this soil is used for crops. Wheat, corn, and alfalfa are the main dryland crops, and corn is the main irrigated crop. Capability units IIc–1, dryland, and I–1, irrigated; Silty Lowland range site; Silty to Clayey windbreak suitability group.

Hersh Series

The Hersh series consists of deep, well-drained, nearly level to steep soils of upland valleys and hills (fig. 7). These soils formed in a mixture of sandy and loamy windblown material.

In a representative profile the surface layer is dark grayish-brown fine sandy loam about 2 inches thick. The next layer is about 14 inches of grayish-brown fine sandy loam. It is very friable. The light brownish-gray underlying material is fine sandy loam in the upper part and loamy fine sand in the lower part.

Permeability is moderately rapid, and available water capacity is moderate. Reaction is slightly acid to mildly alkaline. Natural fertility and organic-matter content are low.

Nearly level to moderately sloping Hersh soils are suitable for cultivation. All the Hersh soils are suitable for grass, windbreak plantings, wildlife habitat, and development for recreation.

Representative profile of Hersh fine sandy loam, 3 to 5 percent slopes (in native range, 0.3 mile east and 250 feet north of the center of sec. 21, T. 17 N., R. 29 W.):

A—0 to 2 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, medium, platy structure parting to weak, fine, granular structure; soft, very friable; slightly acid; clear, smooth boundary.

AC—2 to 16 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak, medium, subangular blocky structure; slightly hard, very friable; neutral; gradual, smooth boundary.

C1—16 to 48 inches, light brownish-gray (10YR 6/2) fine sandy loam, grayish brown (10YR 5/2) moist; weak, medium, prismatic structure; slightly hard, very friable; neutral; gradual, smooth boundary.

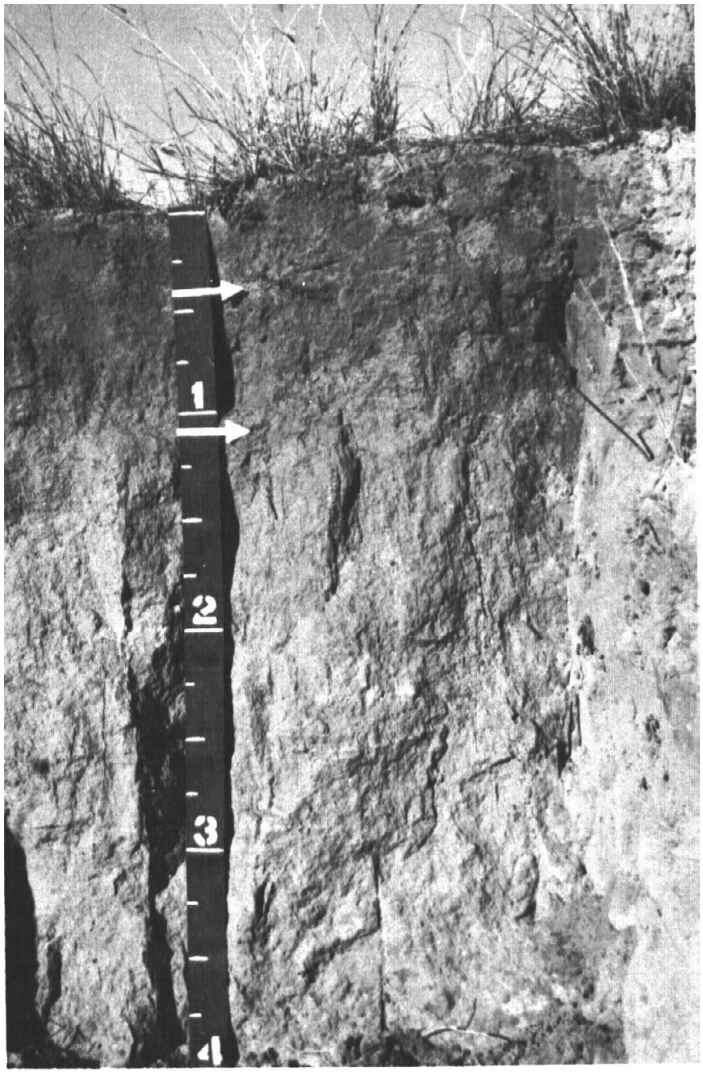


Figure 7.—**Profile of a Hersh fine sandy loam, a weakly developed, moderately coarse textured soil.**

C2—48 to 60 inches, light brownish-gray (10YR 6/2) loamy fine sand, grayish brown (10YR 5/2) moist; single grained; loose; neutral.

The A horizon is dark grayish brown to pale brown and is 2 to 6 inches thick. In cultivated areas there is an Ap horizon consisting of material from the original A, AC, or C horizon. The lower part of the C horizon ranges from silt loam to loamy fine sand.

Hersh soils are associated with Anselmo, Dunday, and Valentine soils. They have a thinner A horizon than Anselmo and Dunday soils. They have a finer textured C1 horizon than Dunday and Valentine soils.

Hersh fine sandy loam, 3 to 5 percent slopes (HeC).—This soil is on upland hills and valleys. Most areas are irregularly shaped and gently undulating. Areas range from 20 to 160 acres in size. This soil has the profile described as representative of the Hersh series.

Included with this soil in mapping are small areas of Anselmo fine sandy loam and Valentine loamy fine sand. Small, severely eroded areas also are included.

Soil blowing is the main hazard if this soil is cultivated. Runoff is slow to medium. Nitrogen and phosphorus are commonly deficient for cultivated crops.

Most of the acreage of this soil is cultivated. Corn, wheat, rye, and alfalfa are the main crops. A few areas are sprinkler irrigated. Corn and alfalfa are the main irrigated crops. Most of the acreage not cultivated is in range. Capability unit IIIe-31, dryland, and IIIe-3, irrigated; Sandy range site; Sandy windbreak suitability group.

Hersh and Anselmo fine sandy loams, 0 to 3 percent slopes (HfB).—This undifferentiated group is in irregularly shaped areas in some of the upland valleys. Areas range from 20 to 60 acres in size. Some areas of this mapping unit consist entirely of Hersh fine sandy loam, and other areas are almost entirely Anselmo fine sandy loam. Most areas, however, contain both soils. The Hersh soil has a thinner surface layer than the Anselmo soil.

Included with this group in mapping are small areas where the surface layer is loam and loamy fine sand. Also included are small areas of Valentine loamy fine sand, nearly level.

Soil blowing is a hazard if the soils in this group are cultivated. Phosphorus and nitrogen generally are deficient. Runoff is slow.

Nearly all the acreage of these soils is cultivated. Corn, rye, alfalfa, and wheat are the main crops. Corn is the main irrigated crop. A few areas are still in native grass. Capability units IIIe-3, dryland, and IIe-31, irrigated; Sandy range site; Sandy windbreak suitability group.

Hersh and Valentine soils, 5 to 11 percent slopes (HgD).—This undifferentiated group is in irregularly shaped areas that range from 10 to 200 acres in size. Some areas of this mapping unit consist almost entirely of Hersh fine sandy loam, and other areas are largely Valentine loamy fine sand and fine sand. Most areas, however, contain both soils. The Valentine soils are coarse textured, whereas the Hersh soil is moderately coarse textured above a depth of 40 inches.

The Valentine soils in this group have a profile that is similar to the one described as representative of the series, except that they are mostly loamy fine sand in texture. Included in mapping are small areas of Anselmo and Holdrege soils and a few severely eroded areas.

Runoff is slow to medium. Soil blowing and water erosion are severe hazards if the soils in this group are cultivated. Nitrogen and phosphorus generally are deficient for cultivated crops. The irregular topography makes cultivation difficult.

Many areas of this group were cultivated in the past, but most of this acreage has been returned to grass. A few areas are in alfalfa, corn, or rye. Range is now the main use. Capability units IVe-3, dryland, and IVe-3, irrigated; the Hersh soil is in the Sandy range site, and the Valentine soils are in the Sands range site; the Hersh soil is in the Sandy windbreak suitability group, and the Valentine soils are in the Very Sandy windbreak suitability group.

Hersh and Valentine soils, 11 to 31 percent slopes (HgG).—This undifferentiated group is in irregularly shaped areas where sand has blown over and mixed with the silty loess. It includes deep canyon areas and adjoining slopes. The soils are rolling to hilly. Tracts range from 20 to 600 acres in size. Some areas of the mapping unit consist almost entirely of Hersh fine sandy loam.

Other areas are nearly 50 percent Valentine soils. The Hersh and Valentine soils have profiles that are similar to those described as representative of their series, except that the Valentine soils are loamy fine sand in most places.

Included with this group in mapping are many small areas of Coly and Uly soils and Rough broken land, loess. A few small areas of other soils also are included.

The soils in this group are subject to severe soil blowing and water erosion if the protective grass cover is destroyed. They are too rough for cultivation. Nearly all areas are in native range. Capability unit VIe-3, dryland; the Hersh soil is in the Sandy range site, and the Valentine soils are in the Sands range site; the Hersh soil is in the Sandy windbreak suitability group, and the Valentine soils are in the Very Sandy windbreak suitability group.

Hobbs Series

The Hobbs series consists of deep, nearly level to very gently sloping, moderately well drained to well drained soils that formed in silty alluvium. These soils are in narrow upland drainageways or on the outer edge of upland depressions.

In a representative profile the plow layer is grayish-brown silt loam about 8 inches thick. The lower part of the surface is dark grayish-brown silt loam about 14 inches thick. The underlying material is pale-brown silt loam. A buried soil is at a depth of about 32 inches. It is grayish-brown silt loam and extends to a depth of 60 inches or more.

Permeability is moderate, and available water capacity is high. Natural fertility is high, and organic-matter content is moderate.

Most areas of Hobbs soils are used for cultivated crops. These soils also are well suited to grass, trees in windbreaks, wildlife habitat, and development for recreation.

Representative profile of Hobbs silt loam, 1 to 3 percent slopes (in a cultivated field, 0.25 mile north and 0.1 mile east of the southwest corner of sec. 19, T. 17 N., R. 28 W.):

Ap—0 to 8 inches, grayish-brown (10YR 5/2) silt loam, very dark gray (10YR 3/1) moist; weak, medium, blocky structure parting to weak, fine, granular structure; slightly hard, friable; slightly acid; clear, smooth boundary.

A12—8 to 22 inches, dark grayish-brown (10YR 4/2) silt loam, black (10YR 2/1) moist; weak, medium, subangular blocky structure parting to weak, fine, granular structure; hard, friable; slightly acid; clear, smooth boundary.

C—22 to 32 inches, pale-brown (10YR 6/3) silt loam, very dark gray (10YR 3/1) moist; weak, coarse, subangular blocky structure parting to weak, fine, granular structure; hard, friable; neutral; clear, smooth boundary.

Ab—32 to 41 inches, grayish-brown (10YR 5/2) silt loam, black (10YR 2/1) moist; weak, coarse, subangular blocky structure parting to weak, fine, granular structure; hard, friable; neutral; gradual, smooth boundary.

ACb—41 to 60 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak, coarse, subangular blocky structure parting to weak, fine, granular structure; hard, friable; neutral.

The A horizon ranges from gray to dark grayish brown in color, from slightly acid to neutral in reaction, and from 20 to more than 45 inches in total thickness.

Hobbs soils are associated with Hord, Scott, Uly, and Vetal soils. Hobbs soils lack the B horizon that is present in Hord, Scott, and Uly soils. They have a thicker A horizon and better surface drainage than Scott soils. They have a thicker A horizon than Uly soils. Hobbs soils are not so coarse textured as Vetal soils.

Hobbs silt loam, 0 to 1 percent slopes (HhA).—This soil is in irregularly shaped areas of upland drainageways. The areas range from 3 to 30 acres in size.

Included with this soil in mapping are small areas of Hord, Scott, and Vetal soils. Also included are areas where recent flooding has deposited lighter colored material on the surface.

This soil has a slight hazard of flooding. Its use is limited mostly by inadequate rainfall. The hazard of erosion is very slight. Maintaining good tilth is a minor concern. Runoff is slow.

Corn is the main crop grown under both dryfarming and irrigated farming. Wheat is raised in dryfarmed areas. Capability unit IIc-1, dryland, and I-1, irrigated; Silty Lowland range site; Silty to Clayey windbreak suitability group.

Hobbs silt loam, 1 to 3 percent slopes (HhB).—This soil is in irregularly shaped areas of upland valleys and depressions. Areas range from 3 to 40 acres in size. This soil has the profile described as representative of the series.

Included in mapping are small areas of Hord soils and areas that are subject to occasional flooding.

Water erosion is a slight hazard on this soil, and inadequate rainfall is a limitation. Nitrogen is usually deficient for irrigated crops and sometimes for dryland crops. Runoff is medium.

Wheat, corn, and alfalfa are the main dryland crops, and corn is the main irrigated crop. Capability unit IIe-1, dryland, and IIc-1, irrigated; Silty Lowland range site; Silty to Clayey windbreak suitability group.

Holdrege Series

The Holdrege series consists of deep, well-drained, very gently sloping to strongly sloping soils on uplands. These soils formed in loess.

In a representative profile the surface layer is very dark grayish-brown silt loam about 13 inches thick. The subsoil is 20 inches thick. The upper part is friable, dark grayish-brown heavy silt loam; the middle part is firm, grayish-brown silty clay loam; and the lower part is friable, pale-brown silt loam. The underlying material, to a depth of 60 inches or more, is light-gray silt loam.

Permeability is moderate, and available water capacity is high. Natural fertility is high, and organic-matter content is moderate to moderately low.

Holdrege soils are the main soils on the wheat-fallow tablelands. They are suitable for both dryland and irrigated crops and for range, trees in windbreaks, wildlife habitat, and development for recreation.

Representative profile of Holdrege silt loam, 3 to 5 percent slopes (in a cultivated field, 35 feet east and 0.4 mile north of the southwest corner of sec. 10, T. 17 N., R. 26 W.):

Ap—0 to 6 inches, very dark grayish-brown (10YR 3/2) silt loam, very dark brown (10YR 2/2) moist; weak, medium, subangular blocky structure parting to weak, fine, granular structure; slightly hard, friable; slightly acid; abrupt, smooth boundary.

A12—6 to 13 inches, very dark grayish-brown (10YR 3/2) silt loam, very dark brown (10YR 2/2) moist; weak, coarse, subangular blocky structure; slightly hard, friable; neutral; clear, wavy boundary.

B1—13 to 17 inches, dark grayish-brown (10YR 4/2) heavy silt loam, very dark grayish brown (10YR 3/2) moist; weak, coarse, subangular blocky structure parting to weak, medium, subangular blocky structure; slightly hard, friable; mildly alkaline; clear, wavy boundary.

B2t—17 to 25 inches, grayish-brown (10YR 5/2) light silty clay loam, dark grayish brown (10YR 4/2) moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky structure; hard, firm; moderately alkaline; gradual, wavy boundary.

B3—25 to 33 inches, pale-brown (10YR 6/3) silt loam, grayish brown (10YR 5/2) moist; weak, medium, prismatic structure parting to weak, medium, subangular blocky structure; slightly hard, friable; moderately alkaline; gradual, wavy boundary.

C—33 to 60 inches, light-gray (10YR 7/2) silt loam, light brownish gray (10YR 6/2) moist; weak, coarse, prismatic structure; slightly hard, very friable; violent effervescence; moderately alkaline.

The A horizon ranges from 8 to 20 inches in thickness and from gray to very dark grayish brown in color. Reaction is slightly acid to neutral. The B horizon ranges from 12 to 30 inches in thickness, and it has a clay content of 28 to 33 percent. The B horizon ranges from weak or moderate prismatic to weak or moderate subangular blocky in structure. Depth to carbonates ranges from 25 to 42 inches.

In Logan County, Holdrege silt loam, 5 to 11 percent slopes, severely eroded, has a thinner, lighter colored A horizon than is allowed in the range defined for the series. This does not alter the use or management of the soil.

Holdrege soils are associated with Hall, Hord, Scott, and Uly soils. They have a thinner A horizon than Hall soils and a finer textured B horizon than Hord and Uly soils. Holdrege soils have better surface drainage and less clay in the B horizon than Scott soils.

Holdrege fine sandy loam, 2 to 4 percent slopes, overblown (HkC).—This soil is in irregularly shaped areas on uplands. The areas range from 3 to 40 acres in size. The profile of this soil is similar to that described as representative of the series, except that the surface layer is fine sandy loam.

Included with this soil in mapping are small tracts of Holdrege and Hord silt loams and Anselmo fine sandy loam. Also included are small areas of severely eroded soils and areas of soils that have loamy fine sand within 36 inches of the surface.

Soil blowing and water erosion are hazards if this soil is cultivated. Maintaining fertility is a concern if the soil is dryfarmed or irrigated. This soil generally is deficient in nitrogen and phosphorus.

Most of this soil is cultivated. Corn, wheat, sorghums, and alfalfa are the main crops. Capability units IIIe–31, dryland, and IIIe–3, irrigated; Sandy range site; Sandy windbreak suitability group.

Holdrege silt loam, 3 to 5 percent slopes (HoC).—This soil is on loessal uplands. Slopes are long, and some are concave. Areas range from 5 to 200 acres in size. The profile of this soil is the one described as representative of the Holdrege series. Included with this soil in mapping are small areas of eroded soils and areas of Hord soils.

Runoff is medium, and there is a hazard of water erosion if this soil is cultivated. Nitrogen is needed for irrigated crops.

Most of this soil is dryfarmed, but some of it is irrigated. Wheat, corn, and alfalfa are the main crops. A few areas are in grass. Capability units IIIe–1, dryland, and IIIe–1, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Holdrege silt loam, 3 to 5 percent slopes, eroded (HoC2).—This soil mostly occupies large, irregular tracts on loess-covered uplands. Areas range from 5 to 300 acres in size. The profile of this soil is similar to the one described as representative of the Holdrege series, except that the surface layer is thinner. Part of the surface layer has been eroded away in most areas (fig. 8).

Included with this soil in mapping are some small ridgetops where the soil is severely eroded. Also included are small areas of Hord soils in the swales between undulations. Small inclusions of Hall, Hobbs, and Scott soils are in and adjacent to depressions.

Medium runoff creates a hazard of water erosion. The hazard of soil blowing is slight. Maintaining fertility is a concern if this soil is dryfarmed or irrigated. Fertility varies in relation to the degree of erosion, but nitrogen and phosphorus are commonly deficient.

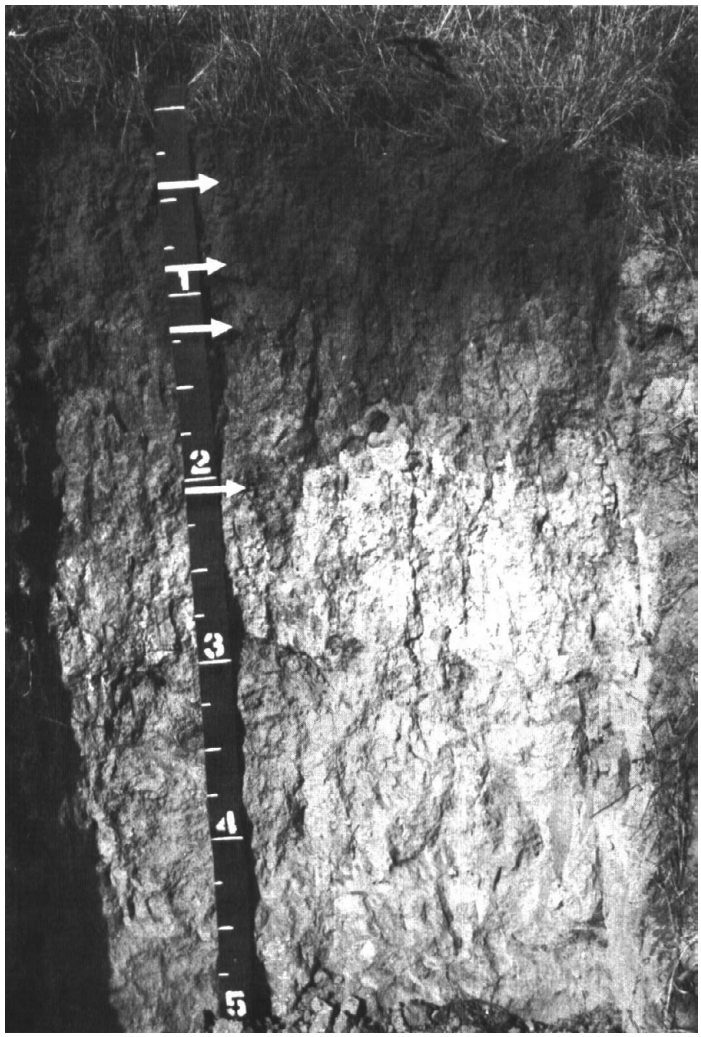


Figure 8.—**Profile of Holdrege silt loam, 3 to 5 percent slopes, eroded. The blocky subsoil underlain by lighter colored loess is typical of soils developed under grass vegetation in central Nebraska.**

This soil is mainly used for dryland farming, and wheat, alfalfa, and corn are the principal crops. Some areas are sprinkler irrigated, and corn is the main irrigated crop. A few areas are in grass. Capability units IIIe–1, dryland, and IIIe–1, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Holdrege silt loam, 5 to 11 percent slopes (HoD).—This soil is on loessal uplands. It mostly occupies long, narrow, concave areas at the base of strongly sloping soils. Areas range from 10 to 80 acres in size. The profile of this soil is similar to that described as representative of the Holdrege series, except that it has a thinner surface layer and subsoil. Included with this soil in mapping are small areas of Uly soils. Also included are small areas of severely eroded soil.

Runoff is medium. The hazard of water erosion is severe if this soil is cultivated.

Most of this soil is in grass. Alfalfa and wheat are the main cultivated crops. Capability units IVe–1, dryland, and IVe–1, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Holdrege silt loam, 5 to 11 percent slopes, severely eroded (HoD3).—This soil occupies elliptical tracts, 5 to 25 acres in size, on convex ridges. It has a profile similar to that described as representative of the Holdrege series, but erosion has removed much of the original surface layer. Included with this soil in mapping are small areas of Coly, Hord, and Uly soils.

Runoff is medium. The hazard of water erosion is severe if this soil is cultivated. Maintaining fertility is a concern in managing this eroded soil. Nitrogen and phosphorus are deficient in most areas.

Much of this soil has been seeded to permanent grass. Wheat and alfalfa are the main cultivated crops. Capability units IVe–8, dryland, and IVe–12, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Holdrege-Hord silt loams, 0 to 3 percent slopes (HpB).—This soil complex is on loess-covered tablelands. About 70 percent of it is Holdrege silt loam, and about 30 percent is Hord silt loam. Areas range from 5 to 200 acres in size. The Hord soil has a thicker surface layer than the Holdrege soil and is in the swales.

Included with these soils in mapping are small areas of Hall and Hobbs soils. Also included are small areas of Scott soils in depressions.

Runoff is slow to medium. Soil blowing and water erosion are slight hazards. Some ponding may occur in swales. Maintenance of fertility is a concern of management, especially if these soils are irrigated.

Wheat, corn, and alfalfa are the principal dryland crops, and corn is the main irrigated crop. Capability units IIe–1, dryland, and IIe–1, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Hord Series

The Hord series consists of deep, well-drained, nearly level to gently sloping soils of the uplands. These soils formed in loess and colluvium in concave positions.

In a representative profile the surface layer is about 20 inches thick. This layer is dark grayish-brown silt loam in the upper part, very dark grayish-brown silt loam in the middle part, and dark grayish-brown silt loam in the lower part. The subsoil is friable silt loam about 17 inches thick. It is dark grayish brown in the upper part and grayish brown in the lower part. The underlying material is brown loam that extends to a depth of 60 inches or more.

Permeability is moderate, and available water capacity is high. Natural fertility is high, and organic-matter content is moderate.

Hord soils are suitable for dryfarmed and irrigated crops, range, windbreak plantings, development for recreation and wildlife habitat.

Representative profile of Hord silt loam, 1 to 3 percent slopes (in a cultivated field, 0.25 mile east and 150 feet south of the northwest corner of sec. 25, T. 17 N., R. 27 W.):

Ap—0 to 4 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak, medium and thick, platy structure parting to weak, fine, granular structure; slightly hard, friable; slightly acid; abrupt, smooth boundary.

A12—4 to 11 inches, very dark grayish-brown (10YR 3/2) silt loam, very dark brown (10YR 2/2) moist; weak, medium, subangular blocky structure parting to weak, medium, granular structure; hard, friable; neutral; clear, smooth boundary.

A13—11 to 20 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak, medium, subangular blocky structure parting to weak, medium and coarse, granular structure; hard, friable; neutral; clear, smooth boundary.

B2—20 to 32 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak, medium, subangular blocky structure; hard, friable; neutral; clear, smooth boundary.

B3—32 to 37 inches, grayish-brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; weak, medium, subangular blocky structure; hard, friable; mildly alkaline; clear, smooth boundary.

C—37 to 60 inches, brown (10YR 5/3) loam, dark brown (10YR 4/3) moist; weak, medium, subangular blocky structure; slightly hard, very friable; mildly alkaline.

The A horizon ranges from 16 to 30 inches in thickness and is slightly acid to neutral in reaction. The B horizon ranges from 14 to 28 inches in thickness and from silt loam to light silty clay loam in texture. It has a clay content of 26 to 30 percent. Dark grayish-brown and grayish-brown colors extend to a depth of 20 to 36 inches. Buried soils that have a clay loam subsoil are below a depth of 40 inches in some places. Depth to lime ranges from 24 to more than 60 inches.

Hord soils are associated with Hall, Hobbs, Holdrege, and Scott soils. Hord soils have less clay in the B horizon than Hall, Holdrege, or Scott soils. They have a B horizon, whereas Hobbs soils do not. They have better surface drainage than Scott soils.

Hord silt loam, 0 to 1 percent slopes (HrA).—This soil is on loess-covered tablelands in tracts that range from 50 to 200 acres in size. Included with it in mapping are small areas of Hall silt loam and Hobbs silt loam. Also included are a few small areas of Scott soils in shallow depressions.

Runoff is slow. Inadequate rainfall is a primary concern of management if the soil is dryfarmed. Soil blowing is a minor hazard. Nitrogen is deficient for irrigated crops.

Nearly all of this soil is used for cultivated crops. Some areas are irrigated. Wheat, corn, alfalfa, and sorghums are the principal dryland crops, and corn is the main irrigated crop. Capability units IIc–1, dryland, and I–1, irrigated; Silty Lowland range site; Silty to Clayey windbreak suitability group.

Hord silt loam, 1 to 3 percent slopes (HrB).—This soil is on tablelands in areas that range from 10 to 200 acres in size. It has the profile described as representative of the Hord series.

Included with this soil in mapping are small areas of Holdrege soils on low ridges and areas of nearly level Hall and Hord soils. Also included are small areas of Hobbs soils along drainageways and Scott soils in depressions.

Soil blowing and water erosion are only slight hazards if this soil is cultivated. Nitrogen generally is deficient for irrigated crops.

Nearly all of this soil is cultivated, but a few small areas are in grass and windbreaks. The principal dryland crops are wheat, corn, and alfalfa. Corn and sorghums are the main irrigated crops. Capability units IIe–1, dryland, and IIe–1, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Hord silt loam, 3 to 5 percent slopes (HrC).—This soil is in concave areas below steeper slopes. It is in long, narrow 5- to 30-acre tracts. Included in mapping are small areas of Holdrege soils.

Runoff is medium. Water erosion is the main hazard if this soil is cultivated.

Most of this soil is cultivated. Wheat, corn, and alfalfa are the principal crops grown. Only a few small areas are irrigated. Some areas are in range. Capability units IIIe–1, dryland, and IIIe–1, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Loup Series

The Loup series consists of deep, poorly drained, nearly level soils in stream valleys. The water table ranges from near the surface in the spring to about 30 inches below the surface in dry seasons.

In a representative profile a 1-inch layer of partially decomposed organic matter covers the surface. The surface layer is gray fine sandy loam about 7 inches thick. Next is a transitional layer of light brownish-gray, very friable loamy fine sand about 7 inches thick. At a depth of 14 inches, and extending to a depth of 60 inches or more, is the underlying material of gray fine sand (fig. 9).

Permeability is rapid, and available water capacity is low. Natural fertility is medium, and organic-matter content is high.

Loup soils are used mostly for hay meadows, but a few small areas are used as range. These soils are too wet for cultivated crops. They are suitable for development as wildlife habitat and for species of trees that can tolerate the effects of the high water table.

Representative profile of Loup fine sandy loam (in a native meadow, near the center of the southwest quarter of sec. 33, T. 18 N., R. 27 W.):

O—1 inch to 0, partially decomposed organic matter.

A—0 to 7 inches, gray (10YR 5/1) fine sandy loam, black (10YR 2/1) moist; weak, fine, granular structure; hard, very friable; strong effervescence; moderately alkaline; clear, wavy boundary.

AC—7 to 14 inches, light brownish-gray (10YR 6/2) loamy fine sand, grayish brown (10YR 5/2) moist; contains thin strata of dark-gray (10YR 4/1 moist) fine sandy loam; single grained; slightly hard, very friable; mildly alkaline; gradual, wavy boundary.

C1—14 to 42 inches, gray (5Y 6/1) fine sand, gray (5Y 5/1) moist; single grained; slightly hard, loose; neutral; clear, smooth boundary.

C2—42 to 60 inches, gray (5Y 5/1) fine sand, dark gray (5Y 4/1) moist; single grained; soft, loose; slightly acid.

The A horizon ranges from 6 to 14 inches in thickness. Reaction ranges from slightly acid to moderately alkaline. The AC horizon ranges from 2 to 9 inches in thickness. There are iron stains in the C horizon of some profiles.

Loup soils are associated with Elsmere, Gannett, and Tryon soils and with Wet alluvial land. Loup soils have a higher water table than Elsmere soils. They have a thinner A horizon than Gannett soils and a thicker A horizon than Tryon soils. Loup soils have a water table that is slightly lower than that of Wet alluvial land.

Loup fine sandy loam (0 to 1 percent slopes) (lo).—This soil is in irregularly shaped tracts adjacent to stream channels. Areas range from 10 to 200 acres in size.

Included with this soil in mapping are small areas of Elsmere, Gannett, and Tryon soils. Also included are small areas of Marsh and Wet alluvial land. A few areas have a loam surface layer.

Runoff is very slow. The water table is too high for cultivated crops; and the soil is too low in relation to streams to be satisfactorily drained. The high water table is beneficial to grass, however.

Most areas of this soil are used as hay meadows. Many of the meadows have been overseeded with legumes, which usually respond to applications of phosphate. Capability unit Vw–3, dryland; Subirrigated range site; Very Wet windbreak suitability group.

Marsh

Marsh (0 to 1 percent slopes) (Ma) is a land type that is in depressions on valley floors and in low areas bordering lakes or streams. It consists of areas where water is at or above the surface. These areas range from 5 to 40 acres in size. The soil material is mainly sandy.

Marsh is too wet to be used for producing hay or pasture. Cattails, rushes, arrowheads, willows, and other water-tolerant plants are common. In the driest years, some areas can be mowed for mulch material. Marsh is better suited to wildlife habitat than to other uses. Capability unit VIIIw–7, dryland; range site not assigned; Undesirable windbreak suitability group.

Ord Series

The Ord series consists of deep, somewhat poorly drained, nearly level to very gently sloping soils on high bottom lands and stream terraces. These soils formed in alluvium. The water table is 30 to 60 inches beneath the surface.

In a representative profile the upper part of the surface layer is dark-gray light fine sandy loam about 4 inches thick. The lower part is dark-gray fine sandy loam about 6 inches thick. Beneath the surface layer is a transitional layer of gray, very friable fine sandy loam about 13 inches thick. The underlying material extends to a depth of 60 inches or more and is light-gray fine sand stratified with 2- or 3-inch layers of finer textured and darker colored material.

Permeability is moderately rapid, and available water capacity moderate. Natural fertility is medium, and organic-matter content is moderate.

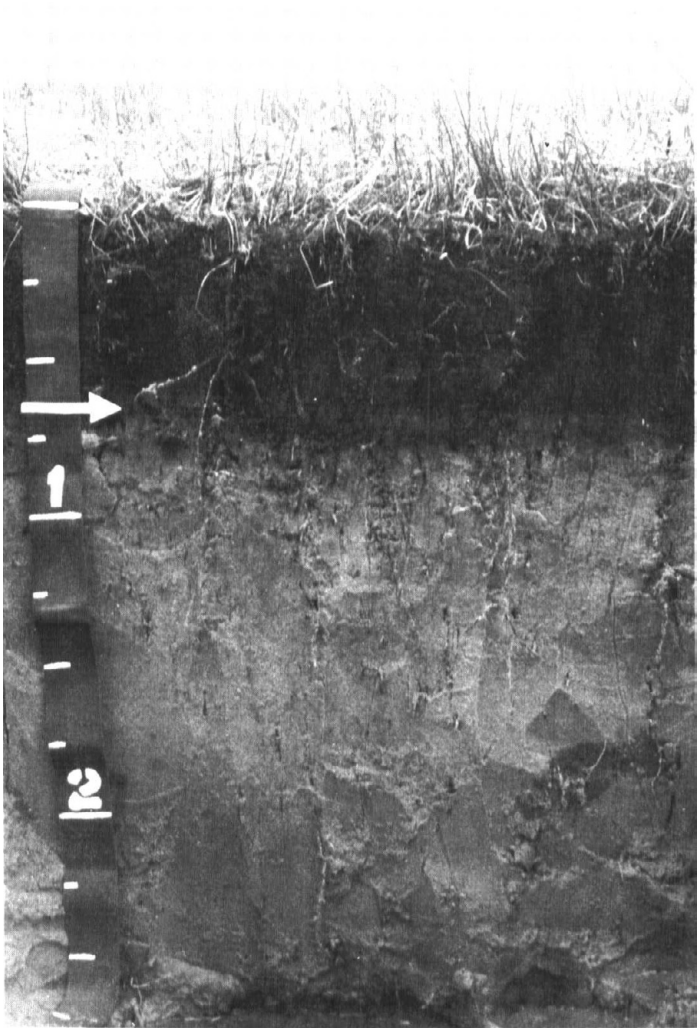


Figure 9.—**Loup soils have a black surface layer that grades to gray, loose fine sand. These soils are poorly drained.**

These soils are suitable for cropping, pasture and range, windbreaks, development for recreation, and wildlife habitat.

Representative profile of Ord fine sandy loam (in a pasture that was cultivated at one time, 0.2 mile east and 0.15 mile north of the center of sec. 32, T. 18 N., R. 27 W.):

Ap—0 to 4 inches, dark-gray (10YR 4/1) light fine sandy loam, very dark gray (10YR 3/1) moist; weak, fine, granular structure; soft, very friable; violent effervescence; moderately alkaline; abrupt, smooth boundary.

A12—4 to 10 inches, dark-gray (10YR 4/1) fine sandy loam, black (10YR 2/1) moist; weak, medium, subangular blocky structure parting to weak, fine, granular structure; slightly hard, very friable; violent effervescence; strongly alkaline; clear, smooth boundary.

AC—10 to 23 inches, gray (10YR 6/1) fine sandy loam, dark gray (10YR 4/1) moist; few, distinct, fine, brownish-yellow (10YR 6/6) mottles; weak, medium and coarse, subangular blocky structure; hard, very friable; slight effervescence; moderately alkaline; gradual, smooth boundary.

C1—23 to 29 inches, light-gray (2.5YR 7/2) fine sand, grayish brown (10YR 5/2) moist; few, distinct, medium, brownish-yellow (10YR 6/6) mottles; single grained; soft, loose; mildly alkaline; abrupt, smooth boundary.

C2—29 to 31 inches, gray (2.5Y 6/1) very fine sandy loam, dark gray (2.5Y 4/1) moist; few, faint, fine, yellowish-brown (10YR 5/6) mottles; massive; hard, very friable; mildly alkaline; abrupt, smooth boundary.

C3—31 to 48 inches, light-gray (2.5Y 7/1) fine sand, gray (2.5Y 5/1) moist; few, distinct, medium, brownish-yellow (10YR 6/6) mottles; single grained; soft, loose; mildly alkaline; abrupt, smooth boundary.

C4—48 to 51 inches, gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist; common, distinct, coarse, yellowish-brown (10YR 5/6) mottles; massive; hard, friable; mildly alkaline; abrupt, smooth boundary.

C5—51 to 60 inches, light-gray (2.5Y 7/1) fine sand, light brownish gray (10YR 6/2) moist; few, distinct, medium, yellowish-brown (10YR 5/6) mottles; single grained; soft, loose; mildly alkaline.

The A horizon ranges from 6 to 14 inches in thickness and from neutral to strongly alkaline in reaction. Buried soils are common. The depth to fine sand ranges from 20 to about 36 inches.

Ord soils are associated with Elsmere, Gannett, Loup, and Ovina soils. Ord soils are finer textured in the upper part of the C horizon than Elsmere soils. They have a lower water table than Gannett and Loup soils. They are deeper to fine sand than Loup and Tryon soils. Ord soils have a higher water table and a coarser textured C horizon than Ovina soils.

Ord fine sandy loam (0 to 3 percent slopes) (Or).—This soil is mostly in irregularly shaped tracts 15 to 50 acres in size. Included with it in mapping are small areas of Ord fine sandy loam, alkali, areas of more poorly drained Loup and Gannett soils, and areas of better drained Ovina soils. Also included are small areas of soils that have a surface layer of silt loam and small areas of soils that are saline-alkali.

Runoff is slow. Soil wetness delays planting in spring, but the high water table can be beneficial in dry seasons. Soil blowing is a minor hazard if the soil is cultivated. Nitrogen and phosphorus generally are deficient for cultivated crops. Small alkali spots can be a minor concern.

About half the acreage of this soil is dryfarmed, and the rest is in pasture and range. Alfalfa is the main cultivated crop, and some corn is planted. Capability units IIw–6, dryland, and IIw–6, irrigated; Subirrigated range site; Moderately Wet windbreak suitability group.

Ord fine sandy loam, alkali (0 to 3 percent slopes) (Os).—This soil is in irregularly shaped tracts 10 to 40 acres in size. This soil has a profile similar to that described as representative of the Ord series, except that some part of the upper 30 inches is strongly or very strongly alkaline.

Included with this soil in mapping are areas where much of the surface layer has been removed or winnowed by soil blowing. Also included are less alkaline areas and small areas of more poorly drained Gannett and Loup soils.

This soil is of limited use because it is so strongly alkaline. This causes some droughtiness and loss of stand. In addition, there is a hazard of soil blowing. Nitrogen, phosphorus, and other elements generally are deficient. Runoff is slow, except in slight depressions where it is very slow or ponded.

Alfalfa is the main cultivated crop. Many formerly cultivated areas have been seeded to grass for hay and pasture. Capability units IVs–1, dryland, and IVs–1,

irrigated; Subirrigated range site; Moderately Saline or Alkali windbreak suitability group.

Ovina Series

The Ovina series consists of deep, moderately well drained, nearly level and very gently sloping soils on stream terraces and high bottom lands. These soils formed in alluvium. The water table is at a depth of 5 to 8 feet.

In a representative profile the upper part of the surface layer is gray fine sandy loam about 5 inches thick. The lower part of this layer is dark-gray very fine sandy loam about 4 inches thick. Beneath this is a transitional layer of very friable, light brownish-gray fine sandy loam about 7 inches thick. The underlying material, which extends to a depth of 60 inches or more, is light-gray fine sandy loam. It has a few yellowish-brown mottles.

Permeability is moderately rapid, and available water capacity moderate. Natural fertility is medium, and organic-matter content is moderately low.

Nearly all the acreage of Ovina soils is cultivated, and most of it irrigated. The soils are suitable for range, windbreak plantings, development for recreation, and wildlife habitat.

Representative profile of Ovina fine sandy loam (in a cultivated field, 0.2 mile west and 0.2 mile south of the northeast corner of sec. 6, T. 17 N., R. 29 W.) :

Ap—0 to 5 inches, gray (10YR 5/1) fine sandy loam, very dark gray (10YR 3/1) moist; weak, thick, platy structure parting to weak, fine, granular structure; soft, very friable; slightly acid; clear, smooth boundary.

A12—5 to 9 inches, dark-gray (10YR 4/1) very fine sandy loam, very dark gray (10YR 3/1) moist; weak, coarse, blocky structure; soft, very friable; neutral; gradual, smooth boundary.

AC—9 to 16 inches, light brownish-gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; many, small, distinct, yellowish-brown mottles; weak, coarse, prismatic structure; soft, very friable; strong effervescence; moderately alkaline; diffuse, wavy boundary.

C—16 to 60 inches, light-gray (10YR 7/2) fine sandy loam, gray (10YR 5/1) moist; few, small, faint and distinct, yellowish-brown (10YR 5/4) mottles; weak, medium, blocky structure; slightly hard, friable; violent effervescence; moderately alkaline.

The A horizon ranges from 6 to 14 inches in thickness and from slightly acid to mildly alkaline in reaction. The AC horizon and the C horizon are fine sandy loam to very fine sandy loam. The depth to lime ranges from the surface to about 40 inches.

Ovina soils in this county have a lower water table than allowed in the range for the series.

Ovina soils are associated with Anselmo, Dunday, and Ord soils. Ovina soils are not so well drained as Anselmo and Dunday soils; they have carbonates higher in the profile and are more stratified than those soils. They are finer textured throughout most of the profile than Dunday soils. Ovina soils are better drained than Ord soils and are not so coarse textured in the lower part of the profile as those soils.

Ovina fine sandy loam (0 to 3 percent slopes) (Ov).—This soil is in irregularly shaped areas that are 15 to 100 acres in size. Included with it in mapping are a few areas of soils that have a surface layer of silt loam, and areas where the soil has been altered by land grading. Also included are areas where soil blowing has winnowed many of the finer particles and much organic matter from the surface layer.

Runoff is slow to medium. Soil blowing and water erosion are hazards if this soil is cultivated. Nitrogen and phosphorus generally are deficient for cultivated crops.

Most of this soil is cultivated, and much of it is irrigated. Corn and alfalfa are the main irrigated and dryland crops. Some wheat is grown in dryland areas. A few small areas are still in native grass, and a few windbreaks have been planted. Capability units IIe–3, dryland, and IIe–3, irrigated; Sandy Lowland range site; Sandy windbreak suitability group.

Rough Broken Land, Loess

Rough broken land, loess (15 to 100 percent slopes) (Rb) is a steep to very steep land type on canyon sides and intervening ridges and valleys, where intermittent drainageways are deeply entrenched in the loess-covered tableland. Most of this land is characterized by catsteps and soil slips (fig. 10). It is in irregularly shaped areas that are 20 to 600 acres in size. Little or no soil development has taken place on the very steep slopes. Partially weathered loess predominates. The surface layer of very fine sandy loam to silt loam is calcareous at or near the surface.

Included with this land type in mapping are a few smoother ridges that are occupied by Coly and Uly soils. Also included are small areas of Hobbs and Valentine soils in and adjacent to the drainageways.

Runoff is very rapid, and water erosion is a severe hazard if the protective grass cover is destroyed. Livestock have difficulty in moving about on the very steep slopes.

All the acreage of this land type is in native grass. There is a scattering of trees and shrubs in some canyons. Rough broken land, loess, is well suited as range and wildlife habitat. Capability unit VIIe–7, dryland; the very steep part (31 to 100 percent slopes) is in Thin Loess range site,

Figure 10.—**An area of Rough broken land, loess, showing typical catsteps and very steep slopes.**

and the steep part (15 to 31 percent slopes) is in Silty range site; Undesirable windbreak suitability group.

Scott Series

The Scott series consists of deep, poorly drained soils that have a claypan subsoil. These soils are in frequently flooded depressions on uplands.

In a representative profile the surface layer is gray silt loam about 8 inches thick. The subsoil is very firm silty clay about 32 inches thick. It is dark gray in the upper part and grayish brown in the lower part. The underlying material is light brownish-gray loam.

Permeability is very slow. Although Scott soils have a high available water capacity, they release moisture slowly to plants. Reaction in the surface layer is slightly acid. Nautral fertility and organic-matter content are high.

These soils are not well suited to cultivated crops unless they are protected from overflow. They can be developed for recreation, such as hunting wildfowl, and are used by wildlife. They are not well suited to trees, and most grasses grow poorly on them.

Representative profile of Scott silt loam in an area of Scott soils (in a cultivated field, 0.35 mile north and 0.1 mile east of the southwest corner of sec. 29, T. 17 N., R. 28 W.):

Ap—0 to 8 inches, gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist; weak, medium, platy structure parting to weak, fine, granular structure; hard, friable; slightly acid; abrupt, wavy boundary.

B21t—8 to 28 inches, dark-gray (10YR 4/1) silty clay, black (10YR 2/1) moist; moderate, medium, blocky structure; very hard, very firm; slightly acid; clear, smooth boundary.

B22t—28 to 40 inches, grayish-brown (10YR 5/2) silty clay, dark olive gray (5Y 3/2) moist; many, large, distinct, dark-brown (10YR 4/3) mottles; moderate, medium, blocky structure; very hard, very firm; neutral; clear, smooth boundary.

C—40 to 60 inches, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; many, large, distinct, dark yellowish-brown (10YR 4/4) mottles; massive; hard, firm; neutral.

The Ap horizon ranges from very fine sandy loam to heavy silt loam in texture and from 0 to 8 inches in thickness. In areas where an Ap horizon is not present, the A1 horizon is 2 to 8 inches thick. In places there is an A2 horizon 1 to 3 inches thick. The B horizon ranges from 24 to 48 inches in thickness and is 40 to 50 percent clay. The C horizon is silt loam to loam in the upper part and ranges from silt loam to loamy fine sand in the lower part.

Scott soils are associated with Hall, Hobbs, Holdrege, and Hord soils. Scott soils have a finer textured B horizon and are in depressed areas lower in elevation than any of those soils.

Scott soils (0 to 1 percent slopes) (Sc).—These soils are in roughly circular tracts in the lowest parts of depressions. These tracts range from 2 to 80 acres in size. The surface layer ranges from very fine sandy loam to heavy silt loam.

Included with these soils in mapping are areas that have accumulated several inches of washed-in silt on the surface and areas that are not so frequently flooded. Also included are a few small intermittent lakes.

These soils have no runoff, and they are frequently flooded. The very slow permeability causes water to remain on the surface for long periods of time. Water on the surface is damaging to most cultivated crops. Some areas have been drained, and others have been filled with soil material during land leveling operations.

About half the acreage of these soils is in cultivated fields, and the remaining areas are used for whatever grazing they afford. The soils are usually too wet for spring planting. Sorghum planted in summer and wheat planted in fall are the main cultivated crops. Establishing most grasses and trees is difficult unless the soils are drained. Capability unit IVw–2, dryland; Clayey Overflow range site; Undesirable windbreak suitability group.

Tryon Series

The Tryon series consists of deep, poorly drained, nearly level soils. These soils developed in alluvium in upland valleys and in the valley of Wild Horse Creek in the Sandhills part of the county. The water table is at a depth of 12 to 36 inches.

In a representative profile there is about 1 inch of partially decomposed organic matter at the surface. The surface layer is dark-gray loamy fine sand about 5 inches thick. Beneath this is loose, light-gray fine sand. At a depth of about 46 inches is a 7-inch layer of very dark gray fine sandy loam that represents an older buried soil.

Permeability is rapid, and available water capacity is low. Natural fertility is low, and organic-matter content is moderately low.

Tryon soils are well suited to hay and pasture but are too wet for the common cultivated crops. They are suitable for wildlife habitat, for some kinds of recreational developments, for grazing livestock, and for growing certain species of trees that can tolerate the high water table.

Representative profile of Tryon loamy fine sand (in a native meadow that has been overseeded with legumes, 0.3 mile north and 0.1 mile west of the center of sec. 16, T. 19 N., R. 26 W.):

O—1 inch to 0, partially decomposed organic matter; slight effervescence.

A—0 to 5 inches, dark-gray (10YR 4/1) loamy fine sand, very dark brown (10YR 2/2) moist; weak, fine, granular structure; soft, very friable; mildly alkaline; clear, smooth boundary.

C1—5 to 46 inches, light-gray (10YR 7/2) fine sand, light brownish gray (10YR 6/2) moist; common, distinct, coarse, brown (10YR 5/3) mottles; single grained; soft, loose; mildly alkaline; clear, smooth boundary.

IIAb—46 to 53 inches, very dark gray (10YR 3/1) fine sandy loam, black (10YR 2/1) moist; massive; hard, very friable; mildly alkaline; gradual, smooth boundary.

IIIC2—53 to 60 inches, light-gray (10YR 7/1) fine sand, dark gray (10YR 4/1) moist; single grained; soft, loose; neutral.

The A horizon ranges from dark gray to very dark grayish brown in color and from 3 to 6 inches in thickness. The lower 1 or 2 inches of the A horizon ranges from loamy fine sand to fine sandy loam and from neutral to moderately alkaline. An AC horizon, 1 to 5 inches thick, is in some areas.

Tryon soils are associated with Els, Elsmere, Loup, and Ord soils. Tryon soils have a higher water table than Els, Elsmere, or Ord soils. They have a thinner A horizon than Loup soils.

Tryon loamy fine sand (0 to 1 percent slopes) (Tn).—This soil occupies small, irregularly shaped tracts in

valleys in the Sandhills part of the county. Included with it in mapping are small areas of Loup soils and the better drained Els and Elsmere soils. Also included are a few small areas of Wet alluvial land and Marsh.

Runoff is very slow. The use of this soil is limited by the high water table. The soil is deficient in available phosphorus, particularly for legumes.

None of this soil is cultivated. Most areas are used as hay meadow, and some have been interseeded with tame grasses and legumes. A few small tracts are used for range. Capability unit Vw–3, dryland; Subirrigated range site; Very Wet windbreak suitability group.

Uly Series

The Uly series consists of deep, well-drained, nearly level to steep soils on uplands and high stream terraces. These soils formed in loess materials.

In a representative profile the surface layer is dark grayish-brown silt loam about 9 inches thick (fig. 11). The subsoil is friable silt loam about 11 inches thick. It is dark grayish brown in the upper part and grayish brown in the lower part. The underlying material is brown silt loam in the upper part, very pale brown very fine sandy loam in the middle part, and light-gray very fine sandy loam in the lower part. It extends to a depth of 60 inches or more.

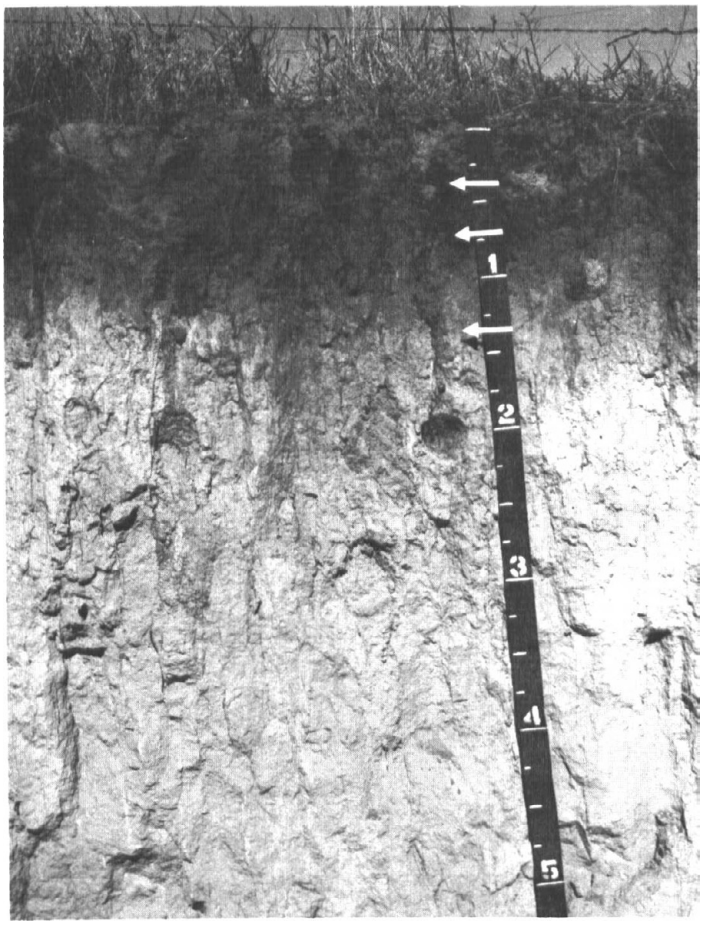


Figure 11.—**A profile of Uly silt loam showing the dark surface layer, the weakly developed subsoil, and the lighter colored loess underlying material.**

Permeability is moderate, and available water capacity high. Natural fertility is medium, and organic-matter content is moderately low.

The nearly level to moderately sloping Uly soils are well suited to cultivated crops. The steeper soils are better suited to range. Uly soils are suited to trees planted for windbreaks, recreational uses, and wildlife habitat.

Representative profile of Uly silt loam in an area of Uly-Holdrege silt loams, 11 to 15 percent slopes (in native grass, 0.5 mile west and 150 feet north of the southeast corner of sec. 9, T. 17 N., R. 28 W.):

A—0 to 9 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak, fine, granular structure; slightly hard, friable; neutral; clear, smooth boundary.

B2—9 to 16 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate, coarse, prismatic structure parting to weak, medium and fine, subangular blocky structure; hard, friable; mildly alkaline; gradual, smooth boundary.

B3—16 to 20 inches, grayish-brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; moderate, coarse, prismatic structure parting to weak, coarse, subangular blocky structure; slightly hard, friable; moderately alkaline; gradual, smooth boundary.

C1—20 to 23 inches, brown (10YR 5/3) silt loam, grayish brown (10YR 5/2) moist; weak, coarse, prismatic structure; slightly hard, friable; moderately alkaline; abrupt, smooth boundary.

C2ca—23 to 44 inches, very pale brown (10YR 8/3) very fine sandy loam, grayish brown (10YR 5/2) moist; weak, coarse, prismatic structure; slightly hard, very friable; violent effervescence; moderately alkaline; gradual, smooth boundary.

C3—44 to 60 inches, light-gray (10YR 7/2) very fine sandy loam, grayish brown (10YR 5/2) moist; weak, coarse, prismatic structure; soft, very friable; violent effervescence; moderately alkaline.

The solum ranges from 12 to 30 inches in thickness. The A horizon ranges from dark grayish brown to brown in color, from 6 to 12 inches in thickness, and from neutral to mildly alkaline in reaction. The B horizon is 6 to 18 inches thick and has a clay content of 18 to 30 percent. The C horizon ranges from very fine sandy loam to silt loam. The depth to lime ranges from 12 to 36 inches.

Uly soils are associated with Coly and Holdrege soils. Uly soils have a thicker A horizon and are deeper to lime than Coly soils, and they have a B horizon that is lacking in those soils. They have less clay in the B horizon than Holdrege soils.

Uly silt loam, 0 to 2 percent slopes (UaA).—This soil occupies 10- to 80-acre tracts on high stream terraces. It has a profile similar to the one described as representative of the series, except that the underlying material is stratified with moderately coarse textured layers. Included with this soil in mapping are small areas where a layer of fine sand has been deposited on the surface. Also included are small areas of Hobbs and Hord soils.

Runoff is medium. Soil blowing and water erosion are slight hazards if this soil is cultivated. Nitrogen is deficient for dryland and irrigated nonleguminous crops.

Most of this soil is cultivated, and some of it is irrigated. Corn and alfalfa are the main dryland and irrigated crops. Some dryland wheat is grown. A few small areas are in grass and trees. Capability units IIe–1, dryland, and IIe–1, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Uly-Coly silt loams, 15 to 31 percent slopes (UcG).—This complex is on ridgetops and in drainageways on the loess-covered uplands of the county. About 40 percent of the mapping unit is Uly silt loam, which is on the smoother hills and ridges. About 30 percent is Coly silt loam, which is on sharp ridges, steep hills, and the sides of drainageways. The rest is made up of minor soils. Areas of the complex range from 20 to 600 acres in size. The Uly soil has a profile similar to that described as representative of the Uly series. The Coly soil has the profile described as representative for the Coly series.

Included with these soils in mapping are areas of Rough broken land, loess, that make up about 10 percent of the total acreage. Also included are areas of Anselmo, Hersh, Hobbs, and Holdrege soils, each of which makes up about 5 percent of the acreage.

Runoff is rapid, and water erosion is a severe hazard if the grass cover is destroyed.

Soils in this complex are too steep for cultivated crops. Nearly all the acreage is in range. Capability unit VIe–1, dryland; the Uly soil is in Silty range site, and the Coly soil is in Limy Upland range site; Silty to Clayey windbreak suitability group.

Uly-Holdrege silt loams, 5 to 11 percent slopes (UhD).—This complex is in small, irregularly shaped areas on low ridges and on the sides of drainageways on the loess-covered tablelands. About 50 percent of the complex is Uly silt loam, which is on the upper part of the landscape. About 25 percent is Holdrege silt loam, and 20 percent is Hord silt loam on the lower part of the landscape. Minor soils make up the remaining 5 percent. Areas of the complex range from 10 to 80 acres in size.

Included with this complex in mapping are small severely eroded areas, and areas of Coly soils on ridgetops.

Runoff is medium, and the hazard of water erosion is severe. Maintaining fertility is a concern if these soils are used for cultivated crops.

About half the acreage of this complex is is grass that is used as pasture and range. Wheat is the main cultivated crop. Capability units IVe–1, dryland, and IVe–1, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Uly-Holdrege silt loams, 11 to 15 percent slopes (UhF).—This complex is in irregularly shaped areas that range from 5 to 300 acres in size. About 40 percent of the mapping unit is Uly silt loam, which is on the upper part of the landscape. About 40 percent is Holdrege silt loam, which is on the lower and concave part of the landscape. Minor soils make up the remaining 20 percent of the complex. The Uly soil in this complex has the profile described as representative of the series. The Holdrege soil has a profile similar to that described as representative of its series.

Included with these soils in mapping are small areas of Coly soils on narrow ridgetops and Hord soils at the base of slopes.

Runoff is rapid, and the hazard of erosion is severe if these soils are cultivated.

Most of the acreage is in native range. A few small areas are in alfalfa and wheat. Capability unit VIe–1, dryland; Silty range site; Silty to Clayey windbreak suitability group.

Valentine Series

The Valentine series consists of deep, excessively drained, nearly level to hilly soils. These soils formed in sandy windblown material.

In a representative profile the surface layer is grayish-brown fine sand about 5 inches thick. Beneath this is a transitional layer of brown, loose fine sand about 4 inches thick. The underlying material is fine sand that is pale brown in the upper 8 inches and very pale brown in the lower part. It extends to a depth of 60 inches or more.

Permeability is rapid, and available water capacity is low. Natural fertility and organic-matter content are low.

Valentine soils are better suited to grass than to most other plants. Nearly level areas are suitable for limited cultivation. These soils are suitable for windbreak plantings, recreational use, and wildlife habitat.

Representative profile of Valentine fine sand, rolling (in native grass, 0.2 mile north and 0.1 mile west of the center of sec. 36, T. 20 N., R. 28 W.):

A—0 to 5 inches, grayish-brown (10YR 5/2) fine sand, dark grayish brown (10YR 4/2) moist; weak, fine, granular structure parting to single grained; soft, loose; slightly acid; abrupt, smooth boundary.

AC—5 to 9 inches, brown (10YR 5/3) fine sand, grayish brown (10YR 5/2) moist; weak, coarse, prismatic structure parting to single grained; soft, loose; slightly acid; clear, smooth boundary.

C1—9 to 17 inches, pale-brown (10YR 6/3) fine sand; pale brown (10YR 6/3) moist; weak, coarse, prismatic structure parting to single grained; loose; slightly acid; gradual, smooth boundary.

C2—17 to 60 inches, very pale brown (10YR 7/3) fine sand, pale brown (10YR 6/3) moist; single grained; loose; neutral.

The A horizon ranges from 1 to 10 inches in thickness but most commonly is 3 to 6 inches thick. It ranges from fine sand to loamy fine sand in texture. Reaction is slightly acid to neutral. The AC horizon is fine sand or loamy fine sand and ranges from 3 to 10 inches in thickness. The C1 horizon is fine sand or loamy fine sand. The C horizons range from light gray to pale brown.

Valentine soils are associated with Dunday, Els, Hersh, and Tryon soils. Valentine soils have a thinner A horizon than Dunday soils. They lack the high water table of the Els and Tryon soils, and they are coarser textured than Hersh soils.

Valentine fine sand, nearly level (0 to 3 percent slopes) (VaB).—This soil is in upland valleys in areas that range from 10 to 80 acres in size. The profile of this soil is similar to that described as representative of the Valentine series, except that it has a slightly thicker surface layer. Included with this soil in mapping are small areas of Dunday loamy fine sand in slightly depressed areas.

Runoff is very slow. The hazard of soil blowing is severe if this soil is cultivated. The low available water capacity and the difficulty of maintaining soil fertility are serious concerns of management when this soil is cultivated. Nitrogen and phosphorus generally are deficient for cultivated crops.

Nearly all the acreage is in grass and is used as range or hayland. A few areas are cultivated and irrigated by sprinkler systems. Capability units VIe–51, dryland, and IVe–51, irrigated; Sandy range site; Very Sandy windbreak suitability group.

Valentine fine sand, rolling (3 to 17 percent slopes) (VaF).—This soil is in areas of rolling dunes. The areas

range from 20 to 10,000 acres in size. A profile of this soil is described as representative of the Valentine series.

Included with this soil in mapping, north of the South Loup River, are small areas of Valentine fine sand, hilly, Valentine fine sand, nearly level, and Dunday soils. Many small areas of Loup soils in swales and small areas of Blown-out land also are included. Included south of the river are small areas of Valentine loamy fine sand, rolling. These inclusions make up about 30 percent of the mapping unit.

Runoff is slow. Soil blowing is a severe hazard where the soil is cultivated or where the grass cover is otherwise damaged or destroyed.

Most of this soil is still in native grass and is used as range or hayland. There are many livestock windbreaks and farmstead windbreaks on this soil. A few areas were dryland cultivated in the past but have since been returned to grass. Capability unit VIe–5, dryland; Sands range site; Very Sandy windbreak suitability group.

Valentine fine sand, hilly (17 to 50 percent slopes) (VaG).—This soil is in irregularly shaped areas of hilly dunes with catsteps and cup-shaped areas. The areas range from 70 to 400 acres in size. The profile of this soil is similar to the one described as representative of the series, except that it has a thinner, lighter colored surface layer (fig. 12).

Included with this soil in mapping are areas, as much as 40 acres in size, of Valentine fine sand, rolling. Also included are small areas of Blown-out land. These inclusions make up less than 30 percent of the mapping unit.

Runoff is slow. Soil blowing is a severe hazard if the grass cover is destroyed or damaged. Slopes are steep enough that it is difficult for grazing animals to move over the areas.

All areas of this soil are in native grass and are used as range. The soil is too steep and too coarse textured for cultivation. Capability unit VIIe–5, dryland; Choppy Sands range site; Very Sandy windbreak suitability group.

Valentine loamy fine sand, nearly level (0 to 3 percent slopes) (VbB).—This soil is in 20- to 200-acre, irregularly shaped areas in upland valleys. The profile of this soil is similar to the one described as representative for the series, except that it is loamy fine sand from the surface to a depth of about 30 inches. Included with this soil in mapping are small areas of Dunday and Hersh soils in shallow swales.

Runoff is very slow. The hazard of soil blowing is severe if this soil is cultivated. The low available water capacity and the difficulty of maintaining soil fertility are concerns where the soil is irrigated or dryland cultivated. Nitrogen and phosphorus generally are deficient for cultivated crops.

About one-third of the acreage is cultivated. Corn, wheat, rye, and alfalfa are the main dryland crops. Corn and alfalfa are the main crops on the small acreage that is irrigated. The rest of the acreage is in grass and is used for range or hayland. Capability units IVe–5, dryland, and IVe–5, irrigated; Sandy range site; Sandy windbreak suitability group.

Valentine loamy fine sand, rolling (3 to 9 percent slopes) (VbE).—This soil is in 20- to 300-acre, irregularly shaped tracts on lower lying uplands. The profile of this soil is similar to the one described as representative for the series, except that it is loamy fine sand from the surface to a depth of about 24 inches. Included with this soil in mapping are small areas of Dunday loamy fine sand, Hersh fine sandy loam, Valentine fine sand, rolling, and Valentine loamy fine sand, nearly level.

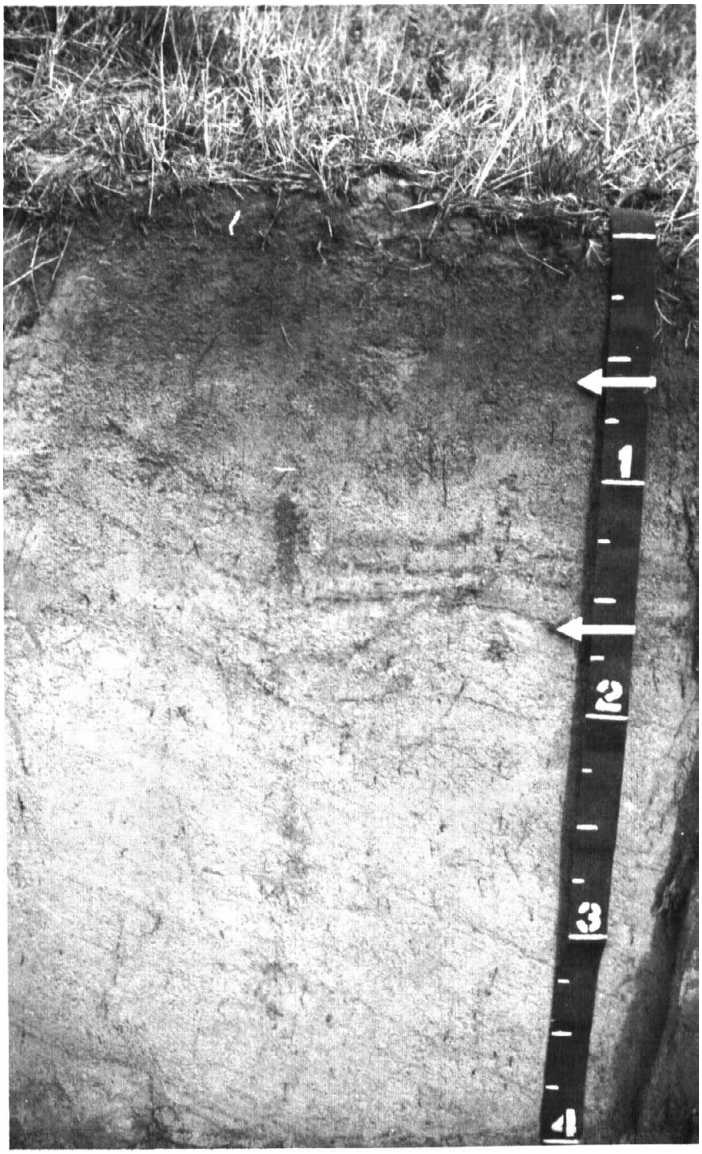


Figure 12.—**Profile of Valentine fine sand, hilly. This coarse-textured soil is subject to severe erosion if it is cultivated. It is best suited to range.**

Runoff is slow. Soil blowing and water erosion are severe hazards if the grass cover is disturbed.

Nearly half the acreage of this soil was cultivated at one time, but most of it has been returned to grass. The soil is better suited to pasture and range than to most other uses. Capability unit VIe–5, dryland; Sands range site; Very Sandy windbreak suitability group.

Valentine complex, hilly (3 to 50 percent slopes) (VcG).—This complex is on rolling and hilly sand dunes. It consists of Valentine fine sand, rolling, and Valentine fine sand, hilly. Each of these soils makes up 30 to 70 percent of the complex. Areas range from 40 to 1000

acres in size. These soils have profiles similar to the one described as representative of the series, except that their surface layer is thinner. In the hilly part there are many catsteps and small cup-shaped areas. Included with these soils in mapping are a few small areas of Dunday soils in narrow valleys, and some areas of Blown-out land.

The hazard of soil blowing is severe if the protective grass cover is destroyed. It is difficult for animals to move about on the hilly topography.

Nearly all the acreage of this complex is in native grass and is used as range (fig. 13). Mowing the grass for hay is difficult, except on the more gentle slopes. Capability unit VIIe–5, dryland; the rolling part (3 to 17 percent slopes) is in Sands range site, and the hilly part (17 to 50 percent slopes) is in Choppy Sands range site; Very Sandy windbreak suitability group.

Vetal Series

The Vetal series consists of deep, well-drained, nearly level soils. These soils formed in alluvium in upland swales and drainageways.

In a representative profile the surface layer is dark grayish-brown fine sandy loam about 23 inches in thickness. Beneath this is a transitional layer of friable, grayish-brown fine sandy loam 7 inches thick. At a depth of 30 inches, and extending to 60 inches or more, is the underlying material of light brownish-gray fine sandy loam.

Permeability is moderately rapid, and available water capacity moderate. Reaction in the surface layer is neutral. Natural fertility is medium, and organic-matter content is moderately low.

These soils are well suited to dryland and irrigated crops, grass, or trees in windbreaks. They also are suitable for recreational development and wildlife habitat.

Representative profile of Vetal fine sandy loam (in a cultivated field, 0.25 mile north and 0.3 mile east of the southwest corner of sec. 22, T. 17 N., R. 27 W.):

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak, medium, subangular blocky structure; soft, very friable; neutral; clear, smooth boundary.

A12—7 to 15 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak, medium, subangular blocky structure; soft, very friable; neutral; gradual, wavy boundary.

A13—15 to 23 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak, medium, subangular blocky structure; soft, very friable; neutral; clear, smooth boundary.

AC—23 to 30 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 3/2) moist; weak, medium, subangular blocky structure; slightly hard, very friable; mildly alkaline; gradual, wavy boundary.

C—30 to 60 inches, light brownish-gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, very friable, mildly alkaline.

The Ap horizon ranges from dark grayish brown to grayish brown. The thickness of the A horizon ranges from 20 to 36 inches. The AC horizon is 3 to 10 inches thick. The C horizon ranges from fine sandy loam to stratified silt loam and fine sand.

Vetal soils are associated with Anselmo and Hobbs soils. They have a thicker A horizon than Anselmo soils and are coarser textured than Hobbs soils.

Vetal fine sandy loam (0 to 1 percent slopes) (Vf).—This soil occupies elongated swales and drainageways that range from 10 to 80 acres in size. Included with it in mapping are small areas of Anselmo and Hobbs soils.

Runoff is slow. There is a slight hazard of soil blowing if this soil is cultivated. In addition, there is a slight hazard of flooding. Maintenance of fertility is a concern if the soil is irrigated.

Most of the acreage is cultivated under dryland management. Sorghum, corn, and wheat are the main crops. Corn is the principal irrigated crop. Capability units IIe–3, dryland and IIe–3, irrigated; Sandy range site; Sandy windbreak suitability group.

Wet Alluvial Land

Wet alluvial land (0 to 1 percent slopes) (Wa) is a land type that occupies swales, depressions, and old channels adjacent to lakes, marshes, and streams. The water table is at or near the surface most of the time. Areas range from 10 to 100 acres in size.

Wet alluvial land is made up of alternate layers of sandy and silty alluvium and partially decomposed organic matter. In most places there is a thin layer of organic matter on the surface. Beneath this is the very dark gray mineral surface layer. The underlying material is light brownish-gray to light-gray fine sand that commonly is stratified with dark organic layers. Dark mottles are common in all layers. Included with this land type in mapping are small areas of Gannett and Loup soils and Marsh.

Wet alluvial land is very poorly drained. Runoff normally is ponded. Depth to the water table ranges from the surface to about 30 inches. During wet seasons, water is commonly above the surface.

This land is too wet for cultivation. Most of it is used as hay meadow, but there are a few small tracts in range. The land produces an abundance of coarse, low-quality hay. Capability unit Vw–7, dryland; Wet Land range site; Very Wet windbreak suitability group.

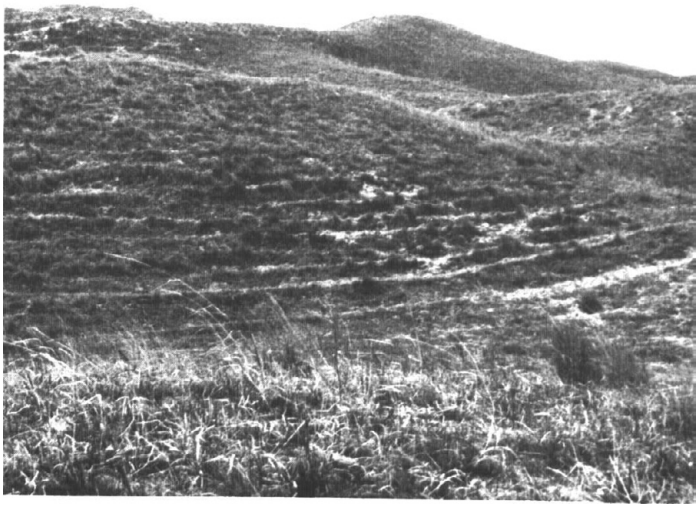


Figure 13.—**Valentine fine sand, hilly, is in the Choppy Sands range site and capability unit VIIe–5, dryland. The very steep slopes have catsteps.**

Use and Management of the Soils

This section provides information on the use and capabilities of the soils for irrigated and dryland crops. The section on range management gives information on the range site classifications in which the different soils have been placed, their correct management, and their potential for producing native grass. The woodland and windbreaks section gives information on the native woodland, suitability of the soils for windbreaks, and suitable trees for each site. The section on wildlife discusses the soil associations in the county and how wildlife habitat is affected by each.

Also discussed in this section is the use of the soils for engineering. Various engineering evaluations and test data are given for the soils in the county.

Management of the Soils for Field Crops

This section discusses general conservation practices needed on the soils under both dryland and irrigated cropping systems.

Most of the soils cultivated in Logan County are silty and well drained. Most are nearly level to gently sloping, though some are steeper. Some nearly level to hummocky, sandy soils are cultivated. The principal crops grown on the silty soils are wheat, corn, and alfalfa. On sandy soils the main crops are alfalfa, corn, and rye. Corn is the principal crop irrigated.

Management of soils for dryland crops [3]

Soils that are cultivated without benefit of irrigation need management that conserves moisture, controls water erosion and soil blowing, and maintains good tilth and fertility.

Terracing, contour farming, and grading in gullies for grassed waterways are all means of conserving moisture and controlling water erosion. Soils in the Holdrege, Uly, and Hord series can benefit from these practices, which work best when used in conjunction with proper vegetation management. Keeping crop residues on the surface or growing a protective cover of plants helps to prevent the soil from sealing or crusting during and after a heavy rain and slows evaporation. Tall stubble left over winter catches drifting snow that adds to soil moisture. Field borders seeded to native grass provide hay, pasture, and cover for wildlife, besides providing space at the end of the field where machinery can be turned. Managing the cropping system so that the better soils on which there is little or no erosion hazard are used mainly for the production of row crops, and steep and sandy soils are used for hay and pasture crops, can help in reducing overall erosion.

The same practices that conserve soil moisture help to reduce soil blowing (fig. 14). Stubble mulch tillage, crop residue management, wind stripcropping, and the

[3] By ERVIN O. PETERSON, conservation agronomist, Soil Conservation Service.

Figure 14.—Stripcropping of wheat and fallow on Hersh fine sandy loam, 3 to 5 percent slopes, helps to control soil blowing. This soil is in capability unit IIIe-31, dryland.

use of narrow field windbreaks all help to reduce wind velocity at the soil surface and thus reduce movement of soil particles. Burning crop residues is not a desirable practice. Cultivated soils that have a coarse textured or moderately coarse textured surface layer, such as those in the Anselmo, Dunday, Hersh, and Valentine series, need protection.

Managing tillage operations so as to eliminate all but the essential operations and using those practices that leave maximum crop residues on the surface are of benefit in improving the physical condition of the soil and help to reduce soil loss. Fewer operations mean less tractor and machinery travel, and this results in less soil compaction and higher intake of water into the soil.

Most soils in Logan County that are used for dryland crops require some nitrogen fertilizers. Barnyard manure, when available, or commercial fertilizer can be used. Growing legumes also helps. The sandy soils are generally low in phosphorus and may require lime for alfalfa. Adequately fertilized crops produce more residue, which helps protect the soil from blowing and water erosion. The kind and amounts of commercial fertilizer applied need to be determined by soil tests. The available supply of moisture also needs to be considered.

Management of soils for irrigated crops

Many of the management practices discussed for dryfarmed areas are also applicable to irrigated land. Soil blowing is reduced because of fewer crop failures and increased plant growth, but there is danger if forage is harvested or grazed too close during winter months. Maintaining good soil tilth is important on irrigated soils. Some practices, such as crop rotations, are beneficial to the soil but may not be economically feasible.

Water can be distributed to the crops in different ways. Furrows, borders, corrugations, controlled flooding, contour ditches, and sprinklers are suitable methods. Soil problems that usually need careful attention are related to soil slope, texture, and the possible need for erosion control. Wet and alkali-affected areas have problems that need special treatment.

The addition of supplemental water causes additional hazards and problems. It increases the hazard of water erosion and the need for drainage and fertilizers. For efficient gravity irrigation, most areas need some land grading. More nearly even distribution of water and better control of runoff can then be provided. Water can also be saved by using concrete-lined ditches, or pipe and wastewater reuse systems. Some soils can best be irrigated with a sprinkler system; field windbreaks reduce wind-distorted sprinkler patterns.

Irrigation generally increases crop production over that obtained on nonirrigated soils. Producing extra grain and forage causes larger amounts of nutrients to be removed from the soil. Consequently, on irrigated soils, maintaining fertility is extremely important. The amount of commercial fertilizer needed depends on the kind of soil, soil management, quality of irrigation water, and the crop yields expected.

The nutrient content of soils can be determined by soil tests, which ought to be made before applying fertilizer. Where deep cuts are made on friable soils, such as the Holdrege, Hord, Hobbs, and Uly, large additions of fertilizer and organic matter will normally improve these areas in a year or two. Zinc may also improve them, but it should first be used on a trial basis. Somewhat poorly drained soils, such as the Elsmere, Els, and Ord, may respond to applications of phosphorus, particularly when planted to legumes. Nitrogen is needed for sustained production of all irrigated crops.

The irrigation developments selected need to be a result of the careful consideration of maximum crop production, the soil problems concerned, the supply of available water, pollution of underground water, and the cost involved. Not all soils are suitable for irrigation.

Capability grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations when used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to horticultural crops or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range, for forest trees, or engineering.

In the capability system, the kinds of soil are grouped at three levels: the capability class, the subclass, and the unit. These are discussed in the following paragraphs.

Capability Classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices, or both.

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V soils are subject to little or no erosion but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife habitat.

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife habitat.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife habitat.

Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife habitat, or water supply, or to esthetic purposes.

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife habitat, or recreation.

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe–1 or IIIe–3. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitations, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass (*6*).

In the following pages the capability units in Logan County are described. The soil series and land types represented in a capability unit are named in the description of that unit, but this does not mean that all the soils of a given series are in that unit. To find the classification of any particular soil, refer to the "Guide to Mapping Units."

CAPABILITY UNITS IIc–1, DRYLAND, AND I–1, IRRIGATED

These units consist of nearly level, deep, moderately well drained and well drained soils on uplands. These soils are of the Hall, Hobbs, and Hord series. They have a surface layer of silt loam that is slightly acid to neutral in reaction.

These soils have moderate to moderately slow permeability and high available water capacity. They are easily worked. Surface runoff is slow, and organic-matter content is moderate.

Insufficient rainfall is a concern if these soils are managed under a dryland system. They are only slightly susceptible to water erosion, but soil blowing is a hazard if these soils are not adequately protected. Maintenance of fertility and management of water are the main concerns if these soils are irrigated.

Dryland management.—These are some of the best soils in the county for cultivation, and they are suited to all crops that grow in this climate. Wheat, corn, alfalfa, and sorghum are the principal dryland crops, and tame grasses, oats, and barley also are suitable.

Summer fallow, to build up soil moisture for fall-seeded wheat, is a common practice. Crop residues kept on the surface during tillage operations help reduce evaporation and increase the moisture intake of the soil. Stripcropping and the return of crop residues lessen the hazard of soil blowing. Fertility is easily maintained by using commercial fertilizers and barnyard manure, by returning crop residues to the soil, and by growing legumes. If there is a shortage of soil moisture, the addition of too much nitrogen can be harmful.

Irrigation management.—Corn is the major crop grown under irrigation, but alfalfa, sorghum, and tame grasses are also important. Fertility can be maintained by applying commercial fertilizers and barnyard manure and by returning crop residues to the soil. The use of manure and residues also helps maintain good tilth. Land grading is needed for a more nearly uniform application of water in areas that are irrigated by a gravity method. Soils in this unit can be cultivated more intensively than most other soils in the county.

CAPABILITY UNITS IIe–1, DRYLAND, AND IIe–1, IRRIGATED

These units consist of very gently sloping soils of the Hobbs and Hord series and nearly level to very gently sloping soils of the Holdrege and Uly series. These are deep, moderately well drained and well drained soils on loessal uplands and stream terraces. They have a surface layer of silt loam that is slightly acid to mildly alkaline.

These soils have moderate permeability and high available water capacity. Runoff is slow to medium. Organic-matter content is moderate, except in the Uly soils, where it is moderately low. These soils are easily worked because they have good tilth.

Soils in these units are slightly susceptible to water erosion and soil blowing if they are not adequately protected. Maintenance of soil fertility and management of water are the main problems if the soils are irrigated.

Dryland management.—When dryfarmed, these soils are well suited to wheat, alfalfa, corn, and sorghum. Tame grasses are also suitable. The most common cropping system is alternate wheat and fallow, along with an occasional row crop or legume.

Runoff and soil blowing can be controlled by a good system of stubble-mulch tillage. If row crops are grown, it may be necessary to control runoff by contour farming and terracing. These measures help to provide soil moisture for crops during dry periods. Fertility is easily maintained by using barnyard manure and commercial fertilizers, by including legumes in the rotation, and by returning crop residues to the soil.

Irrigation management.—Corn is the main irrigated crop on these soils. Some alfalfa, sorghum, and tame grass also are grown.

If a gravity system of irrigation is used, fields need to be graded to help smooth out slopes and distribute water evenly. The slope of furrows needs to be controlled to reduce erosion. This is done by cross-slope irrigating facilitated by contour furrows and bench leveling. Disposal systems are needed for waste water. Fertilizer needs can be met by applying commercial fertilizer and barnyard manure. Crop residues returned to the soil help to maintain good tilth.

CAPABILITY UNITS IIe-3, DRYLAND, AND IIe-3, IRRIGATED

These units consist of nearly level soils of the Anselmo, Ovina, and Vetal series. These are moderately well drained to well drained soils on stream terraces and in upland swales. They have a surface layer of fine sandy loam that is slightly acid to mildly alkaline.

These soils have moderately rapid permeability and moderate available water capacity. They release moisture readily to plants. Surface runoff is slow to medium, and organic-matter content is moderately low.

The soils in these units are slightly susceptible to soil blowing. They are droughty during years of below-average rainfall. The organic-matter content needs to be increased and then maintained. Maintenance of soil fertility and management of water are concerns, particularly if the soils are irrigated.

Dryland management.—If they are dryfarmed, the soils are suited to corn, sorghum, alfalfa, wheat, rye, vetch, and tame grass. Row crops need to be limited in the crop sequence. The use of fallow encourages soil blowing.

Soil blowing can be controlled and soil moisture increased by stubble-mulch tillage and stripcropping. Field windbreaks also are helpful. Cover crops are needed for winter protection in some fields. Fertility and organic-matter content can be maintained by the use of legumes, barnyard manure, and green manure crops, as well as commercial fertilizers.

Irrigation management.—If irrigated, these soils are suited to corn, alfalfa, sorghum, and tame grasses.

Some land grading generally is necessary to prepare the soil for gravity irrigation. This helps in securing an even distribution of irrigation water. The high rate of water intake in these soils makes it necessary to limit the length of irrigation runs. Cover crops or crop residues left on the surface in winter help to control soil blowing. Barnyard manure helps to maintain the organic-matter content and fertility, and commercial fertilizer is needed.

CAPABILITY UNITS IIw-6, DRYLAND, AND IIw-6, IRRIGATED

Ord fine sandy loam is the only soil in these units. It is a deep, nearly level to very gently sloping, somewhat poorly drained soil on high bottom lands and stream terraces. The surface layer of fine sandy loam ranges from neutral to strongly alkaline.

This soil has moderately rapid permeability and moderate available water capacity. Runoff is slow, and organic-matter content is moderate.

The moderately high water table is a concern in wet years but is beneficial in dry years. Tillage is commonly delayed in spring. Maintaining soil fertility, controlling small included alkali areas, and controlling soil blowing can also be problems on this soil.

Dryland management.—When dryfarmed, this soil is suitable for corn, alfalfa, forage sorghum, rye, wheat, and tame grass.

By using crops such as alfalfa and grass that do not require spring cultivation, most of the wetness limitation can be overcome. It is necessary to maintain high fertility in order to stimulate root growth and overcome the effects of alkali spots. This can be done by the use of barnyard manure and commercial fertilizer. Heavy applications of phosphate fertilizer are needed. Soil blowing can be controlled by keeping crop residues on the soil surface, especially during tillage and seedbed preparations. Cover crops or crop residues are needed to protect the soil in winter.

Irrigation management.—Crops suited to this soil under irrigation are corn, alfalfa, forage sorghum, and tame grass.

Land grading is necessary in gravity irrigated fields. Improved surface drainage is needed in most fields that are sprinkler irrigated. Applications of water should be small but frequent. Heavy applications of barnyard manure and phosphate fertilizer are needed. Nitrogen fertilizer can be applied in split applications to avoid excessive leaching into the water table.

CAPABILITY UNITS IIIe-1, DRYLAND, AND IIIe-1, IRRIGATED

These units consist of deep, well-drained, gently sloping soils on loess-covered uplands. These soils are of the Holdrege and Hord series. They have a surface layer of silt loam that is slightly acid to neutral. Some areas are moderately eroded.

These soils have moderate permeability and high available water capacity. Runoff is medium, and organic-matter content is moderate. The soils are easily worked and release moisture readily to plants.

Soils in these units are moderately susceptible to water erosion and slightly susceptible to soil blowing. Maintenance of soil fertility and management of irrigation water are concerns if the soils are irrigated.

Dryland management.—When dryfarmed, these soils are suited to wheat, corn, alfalfa, sorghum, and tame grass. A cropping system of alternate wheat and fallow is commonly used, along with an occasional row crop or legume. Row crops can best be used where the soil is terraced.

Water erosion can be controlled by contour farming and terracing. The short irregular slopes make these practices difficult to use in some areas. A good system of stubble-mulch farming helps control water erosion and soil blowing. Special attention should be given to eroded areas when applying barnyard manure and commercial fertilizer.

Irrigation management.—Corn, sorghum, and alfalfa are the commonly irrigated crops, but tame grass, oats, and barley also are grown under irrigation.

A sprinkler system is the most suitable method of irrigating these soils. A gravity system of irrigation requires heavy grading, together with terraces or benches, to achieve uniform distribution of water and control of erosion. Heavy applications of barnyard manure, as well as commercial fertilizer containing trace elements, are needed in areas where the original surface layer has been removed by land grading.

CAPABILITY UNITS IIIe-3, DRYLAND, AND IIe-31, IRRIGATED

These units consist of nearly level to very gently undulating, well-drained soils of the Anselmo and Hersh series. These soils are in upland valleys. They have a surface layer of fine sandy loam that is slightly acid to neutral.

These soils have moderately rapid permeability and moderate available water capacity. Runoff is slow, and organic-matter content is low to moderately low. Moisture is absorbed readily.

Maintaining soil fertility is a problem. The soils are

moderately susceptible to soil blowing and slightly susceptible to water erosion. They are droughty in years of below-average rainfall if they are cultivated under a dryland system of management.

Dryland management.—When dryfarmed, these soils are suited to corn, rye, vetch, sorghum, alfalfa, and tame grass.

Both soil blowing and water erosion can be controlled and moisture can be conserved by stripcropping, using mulch tillage, planting field windbreaks, and using a cropping system that keeps the soil covered most of the time. Fertility can be maintained through the use of barnyard manure, commercial fertilizer, legumes, and crop residues.

Irrigation management.—Suitable crops for these soils under irrigation are corn, alfalfa, sorghum, and tame grass.

Land grading is needed for gravity irrigation. Irrigation runs should be kept short to avoid applying too much water. Cross-slope row directions will reduce water erosion. Soil blowing can be reduced in winter by planting cover crops and returning crop residues to the soil. Soil fertility can be maintained by using barnyard manure and commercial fertilizer. Some areas require heavy applications of phosphate and lime for legumes.

CAPABILITY UNITS IIIe-31, DRYLAND, AND IIIe-3, IRRIGATED

These units consist of gently sloping soils of the Anselmo, Hersh, and Holdrege series. These are deep, well-drained soils on uplands and in upland valleys. They have a surface layer of fine sandy loam that is slightly acid to neutral.

These soils have moderate to moderately rapid permeability. The available water capacity is moderate to high. Runoff is slow to medium. Organic-matter content is moderately low. The soils absorb moisture and release it readily to plants.

Maintaining soil fertility is a concern on these soils. The soils are moderately susceptible to soil blowing and slightly susceptible to water erosion. In years of below-average rainfall, they are droughty. Management of irrigation water is a problem if the soils are irrigated.

Dryland management.—When dryfarmed, these soils are suited to corn, alfalfa, rye, vetch, and tame grass. Nearly half the acreage of these soils is in native grass that is used as range or hayland.

Soil blowing and water erosion can be controlled and moisture conserved by the use of stripcropping and field windbreaks, along with a system of stubble-mulch tillage. Crop residues and cover crops help protect the soil in winter. Barnyard manure and commercial fertilizer are needed to maintain soil fertility.

Irrigation management.—Suitable crops for these soils under irrigation are corn, alfalfa, sorghum, and tame grass.

These soils require heavy land grading if a gravity system of irrigation is used; sprinkler irrigation generally is more practical. Water applications need to be light but frequent. Soil blowing and water erosion can be controlled by keeping crop residues on the surface and using cover crops for winter protection. Soil fertility can be maintained by the use of commercial fertilizer and barnyard manure. Eroded areas and areas where the original surface layer was removed during land grading need special attention. Some areas require lime as well as phosphate for a good stand of alfalfa.

CAPABILITY UNITS IVe-1, DRYLAND, AND IVe-1, IRRIGATED

These units consist of deep, moderately sloping soils of the Holdrege and Uly series. These are well-drained soils on loess-covered uplands. They have a surface layer of silt loam that is slightly acid to mildly alkaline.

These soils have moderate permeability and high available water capacity. Runoff is medium. Organic-matter content is moderately low or moderate. These soils release moisture readily to plants.

The hazard of water erosion is severe, but that of soil blowing is only slight. Maintenance of fertility and management of irrigation water are concerns if the soils are irrigated.

Dryland management.—When dryfarmed, these soils are suited to wheat, alfalfa, sorghum, tame grass, and corn. Some areas are in native grass and are used as range or hayland.

If these soils are cultivated, it is important to control erosion. Terracing, contour farming, and grassed waterways can be used on smooth, regular slopes. An alternative for irregular slopes is to use the soils for close-growing crops or for pasture, hayland, or range. Row crops need to be limited in the cropping sequence in order to reduce soil loss and maintain good tilth. Using crop residues as mulch material during tillage and seedbed preparation helps reduce erosion losses. Barnyard manure or commercial fertilizer is needed to maintain fertility.

Irrigation management.—Alfalfa and grasses are the crops most suitable for these soils under irrigation. Corn and sorghum are suitable if erosion control methods are used.

The steepness of slope makes it difficult to control erosion that is caused by rainfall and the application of irrigation water. Water needs to be carefully applied at a rate that does not exceed the intake rate of the soil. The sprinkler system is the best method for irrigating these soils. Erosion can be controlled by terracing, contour farming, using grassed waterways, and leaving crop residues on the surface. Furrow and border methods of irrigation are suitable if the soils are contour bench leveled. Grass can be irrigated from contour ditches. Irrigation is not advisable where slopes are more than 8 percent, because of the erosion hazard. Soil fertility can be improved and maintained by the use of commercial fertilizer and barnyard manure.

CAPABILITY UNITS IVe-3, DRYLAND, AND IVe-3, IRRIGATED

These units consist of moderately sloping soils of the Anselmo, Hersh, and Valentine series. These are deep soils that are well drained, except for the Valentine soil, which is excessively drained. Their surface layer is slightly acid to neutral and, except in the Valentine soil, is fine sandy loam. In the Valentine soil, this layer is loamy fine sand. Soils of the unit are gently rolling and on uplands.

These soils have moderately rapid to rapid permeability. Available water capacity ranges from low to moderate. Runoff is slow to medium, and organic-matter content is low or moderately low.

These soils are highly susceptible to soil blowing.

Because of slope, water erosion is a moderate hazard. Water enters the soils readily.

Dryland management.—When dryfarmed, these soils are suited to alfalfa, rye, vetch, corn, sorghum, and tame grass. Most areas, however, are in grass and are used as pasture or range.

Soil blowing and water erosion can be reduced and moisture can be conserved by using a cropping system that keeps the soil covered most of the time. Wind stripcropping and field windbreaks reduce soil blowing and conserve moisture. Summer fallowing is hazardous on these soils and the use of row crops needs to be limited. Close-growing crops and legumes protect the soil. Returning crop residues to the soil and applying barnyard manure help maintain and improve the organic-matter content. Commercial fertilizers can be used in years of normal or above-average moisture.

Irrigation management.—Alfalfa and tame grass are the only crops suited to these soils under irrigation.

Gravity irrigation is difficult on these soils. Very heavy grading is required. The slopes are too irregular for the practical installation of the terraces that are required for contour irrigation. Sprinkler systems are better suited. Irrigation water needs to be applied frequently because heavy applications of water cause excessive leaching of fertility. Phosphorus is needed for alfalfa, and nitrogen needs to be applied several times a season on grass.

CAPABILITY UNITS IVe–5, DRYLAND, AND IVe–5, IRRIGATED

These units consist of deep, nearly level to very gently undulating soils of the Dunday and Valentine series. These soils have a surface layer of slightly acid to neutral loamy fine sand. They are somewhat excessively drained and excessively drained soils on stream terraces and in upland valleys.

These soils have rapid permeability and low available water capacity. Runoff is very slow. The organic-matter content is low or moderately low and needs to be improved.

Maintaining soil fertility is a serious problem. If the soils are not protected, they are highly susceptible to soil blowing. They are droughty, even in years of normal rainfall. Because the hazards are severe, these soils need careful management where they are cultivated. They released moisture readily to plants.

Dryland management.—When dryfarmed, these soils are suited to alfalfa, rye, vetch, tame grass, corn, and sorghum. Planting rye or rye and vetch between corn rows in fall as a winter cover crop is a common practice. The rye, or rye and vetch, can be pastured, cut for hay, or left for grain harvest. Most areas of these soils, however, are in grass that is used for hay and pasture.

Soil blowing can be reduced, moisture conserved, and the organic-matter content and fertility maintained by using a cropping system that keeps the soil covered with crops, grass, or crop residues. Row crops need to be limited in the cropping sequence and maximum use made of close-growing crops that protect the soil and conserve moisture. Stripcropping and field windbreaks can also be used to control soil blowing. Returning crop residues to the soil and using barnyard manure help to increase the organic-matter content and improve fertility. Lime and phosphorus are needed for alfalfa. Phosphorus and nitrogen can be used on other crops in years of higher than normal rainfall.

Irrigation management.—If they are irrigated, these soils are suited to corn, sorghum, alfalfa, and tame grass.

Heavy land grading is required for gravity methods of irrigation. Water needs to be piped or carried in concrete-lined ditches. Irrigation runs need to be very short. Sprinkler irrigation is more practical. Applications of water should be light and frequent. Nitrogen fertilizers commonly are leached below the root zone. Soil blowing can be controlled by using a stubble-mulch system of tillage, returning crop residues to the soil, using winter cover crops, and planting close-growing crops. Barnyard manure and commercial fertilizer are needed on this soil.

CAPABILITY UNITS IVe–8, DRYLAND, AND IVe–12, IRRIGATED

Holdrege silt loam, 5 to 11 percent slopes, severely eroded, is the only soil in these units. It is a deep, moderately sloping, well-drained soil on loessal uplands. The soil has a surface layer of silt loam that is neutral in reaction.

This soil is moderately permeable, and its available water capacity is high. Runoff is medium, and organic-matter content is moderately low.

Improving tilth and fertility are problems if this soil is cultivated. The soil is highly susceptible to soil blowing. This soil needs careful management where it is cultivated.

Dryland management.—When dryfarmed, this soil is suited to wheat, alfalfa, corn, spring grain, sorghum, and tame grass. Alfalfa and native grass are better suited than most other plants.

Runoff and erosion can be controlled by terracing, using grassed waterways, contour farming, and returning crop residues to the soil. A cropping system that keeps the soil covered most of the time and the cultivation of close-growing crops, such as grass and alfalfa, protect the soil and help improve organic-matter content and fertility. Barnyard manure and commercial fertilizer can be used to improve fertility.

Irrigation management.—This soil is suited to alfalfa, tame grass, and small grains grown under irrigation.

Sprinkler irrigation is generally more practical than gravity methods. Contour ditches can be used for irrigating grass on the smoother slopes. Terracing and contour farming help to control water erosion. Returning all residues to the soil and growing grass and legumes increase the organic-matter content and fertility and improve soil tilth. Adding barnyard manure also helps. Nitrogen and phosphorus fertilizers are needed for a good response from crops.

CAPABILITY UNITS IVs–1, DRYLAND, AND IVs–1, IRRIGATED

Ord fine sandy loam, alkali, is the only soil in these units. It is a deep, nearly level to very gently sloping, somewhat poorly drained soil on high bottom lands and low stream terraces. The surface layer is moderately to strongly alkaline, and within 30 inches of the surface is a soil horizon that is very strongly alkaline.

This soil has moderately rapid permeability, though root growth is restricted by the alkali layer. Choice of crops is somewhat restricted. Runoff is slow, and available water capacity is moderate. Organic-matter content is moderate, except in some eroded areas where it is low.

Maintaining soil fertility and controlling soil blowing are problems on this soil.

Dryland management.—When dryfarmed, this soil is better suited to alfalfa and alkali-tolerant grasses than to most other plants, but corn and forage sorghum also can be grown.

Soil blowing can be controlled by stripcropping, using field windbreaks, and stubble-mulch farming. Soil fertility can be improved by growing legumes, returning crop residues to the soil, and using barnyard manure and commercial fertilizer. Heavy applications of phosphate fertilizer encourage root growth and help overcome the effects of the alkali.

Irrigation management.—Crops suitable for irrigated areas of this soil are corn, alfalfa, forage sorghum, and tame grass.

Gravity methods of irrigation require land grading and concrete-lined ditches or gated pipe. Some grading generally needs to be done on sprinkler-irrigated fields to improve surface drainage. Applications of water need to be light and frequent. Soil blowing can be controlled by using close-growing crops, stubble-mulch tillage, and winter cover crops. Sulfur or gypsum can help neutralize the alkali in trouble spots. Barnyard manure, nitrogen, and heavy applications of phosphate fertilizer are needed.

CAPABILITY UNIT IVw–2, DRYLAND

This unit consists only of Scott soils. These are deep, nearly level, poorly drained soils in upland depressions. The surface layer of silt loam to very fine sandy loam is slightly acid.

These soils have very slow permeability because of the claypan subsoil. The available water capacity is high, but this is not important, because permeability is so slow.

Runoff tends to be ponded, which makes cultivation difficult or nearly impossible in spring. Maintaining soil tilth is a serious concern. Because of wetness and the serious hazard of flooding, cultivation is marginal. Choice of crops is restricted.

Crops that are suited to these soils are winter wheat and forage sorghum, for these crops require no tillage early in spring. Tame grass also is suited. Scott soils are used by wildlife but are not suitable for trees.

Constructing terraces on adjacent higher land reduces the risk of flooding on these soils. Outlets generally are not available for drainage. Returning crop residue to the soils and refraining from tilling them when they are wet will help maintain good soil tilth.

CAPABILITY UNIT Vw–3, DRYLAND

This unit consists of soils of the Gannet, Loup, and Tryon series. These are deep, nearly level, poorly drained soils on bottom lands, stream terraces, and valleys in the Sandhills. Their surface layer of fine sandy loam or loamy fine sand is slightly acid to moderately alkaline.

The soils in this unit have moderate to rapid permeability. The available water capacity is moderate to low, but this is not important, because the water table is at or near the surface during most of the year. Runoff is very slow to ponded, and the organic-matter content ranges from moderately low to high.

The main limitation that affects the use of these soils is excessive wetness; the more desirable grasses can be drowned out. Haying operations are difficult during wet seasons. Bogs commonly form in these soils if they are grazed by cattle when the water table is at the surface.

These soils are too wet for cultivation. Most areas are used as native meadows. A few small areas are used for range. Wildlife use these areas, and the soils are suitable for constructing fish ponds. Certain species of trees can tolerate the excessive wetness.

Outlets generally are not available for drainage, but a few meadows have been improved with V-ditches to help surface drainage. Proper stocking and deferred grazing of pastured areas help to maintain grass production and prevent the formation of boggy areas. The quality of hay can be improved by seeding red clover. Phosphate fertilizer will aid in the establishment and growth of legumes.

CAPABILITY UNIT Vw–7, DRYLAND

Only Wet alluvial land is in this unit. This land type is nearly level and consists of deep soil material in which there are alternate layers of silt, sand, and organic matter. It is very poorly drained and is adjacent to lakes, marshes, and streams. The water table is at or near the surface.

Runoff is very slow or ponded. Organic-matter content is high, and natural fertility is medium. Extreme wetness and flooding are the main hazards to use.

The main use of this land is for native hay meadow. The land is too wet for cultivation and, in some years, is even too wet for haying. It produces large quantities of rather poor quality forage. A few areas are used for pasture or range. This land type is used by wildlife and is suitable for constructing fish ponds, but it is poorly suited to most trees for windbreak plantings.

This land is difficult to drain adequately, but some hay meadows can be improved by installing V-ditches to hasten surface drainage. Proper stocking and deferred grazing of pastured areas help to maintain grass production and to prevent the formation of boggy areas. There is a possibility of increasing the quality of hay produced by seeding these areas to grasses, such as reed canarygrass.

CAPABILITY UNIT VIe–1, DRYLAND

This unit consists of strongly sloping to steep soils of the Coly, Holdrege, and Uly series. These are deep, well-drained soils on loessal uplands. They have a surface layer of silt loam that is neutral to mildly alkaline.

Soils of this unit have moderate permeability and high available water capacity. Runoff is medium to rapid. The organic-matter content is low to moderately low.

These soils are highly susceptible to water erosion; keeping the grass cover vigorous and healthy is the principal concern of management.

The soils in this unit are better suited to native grass than to most other plants. They are not suitable for cultivation, because of the erosion hazard and the steepness of slope. They are suited to trees for windbreaks, development for recreation, and wildlife habitat.

The few areas presently cultivated can be seeded to native grass and thus converted to range. Proper stocking and deferred grazing help to maintain and improve grass stands. Leaving about half the year's growth of grass at the close of the grazing season protects the soil and slows runoff. More uniform grazing can be obtained by proper placement of salt and water. Soils in this unit

are suited to stock water dams, but these are not a dependable source of water.

CAPABILITY UNIT VIe-3, DRYLAND

This unit consists only of Hersh and Valentine soils, 11 to 31 percent slopes. These are deep, strongly sloping to steep, well-drained to excessively drained soils on uplands (fig. 15). They have a surface layer of fine sandy loam, loamy fine sand, or fine sand that is slightly acid or neutral.

These soils have moderately rapid to rapid permeability and moderate to low available water capacity. Runoff is medium.

These soils are highly susceptible to soil blowing if the grass cover is removed. The hazard of water erosion is severe. The soils are too steep and the hazard of erosion is too great for successful cultivation.

The soils in this unit are not suited to cultivated crops. They are better suited to native grass. They also are suited to trees in windbreaks, limited recreational development, and wildlife habitat.

Proper stocking and deferred grazing help to maintain and improve stands of grass and to control erosion. More nearly uniform grazing can be obtained by proper placement of fences, salt, and water. Stock water dams are suited to these soils but are not a dependable source of water, because of the moderately rapid and rapid permeability.

CAPABILITY UNIT VIe-5, DRYLAND

This unit consists of gently sloping to strongly sloping soils of the Dunday and Valentine series. These are deep, somewhat excessively to excessively drained soils on uplands in the Sandhills. They have a surface layer of loamy fine sand or fine sand that is slightly acid or neutral.

These soils have rapid permeability and low available water capacity. Moisture is readily absorbed and released to plants. Runoff is slow, and organic-matter content is low.

These soils are highly susceptible to soil blowing if the protective grass cover is destroyed. Keeping the grass vigorous and healthy is the principal concern of management. The hazard of water erosion is only slight.

***Figure 15.*—An area of Hersh and Valentine soils, 11 to 31 percent slopes. These soils are in capability unit VIe-3, dryland.**

Soils in this unit are not suited to cultivated crops. They are better suited to native grass used as range than to most other plants. Some areas are used as hayland. These soils also are suited to wildlife habitat and to coniferous trees in windbreaks.

Proper stocking and deferred grazing help to maintain and improve grass stands and to control erosion. More nearly uniform grazing can be obtained by proper placement of fences, salt, and water. Areas that have been cultivated need to be fenced and seeded to native grasses.

CAPABILITY UNITS VIe-51, DRYLAND, AND IVe-51, IRRIGATED

The only soil in these capability units is Valentine fine sand, nearly level. It is a deep, nearly level to very gently sloping, excessively drained soil in valleys in the Sandhills. The surface layer is slightly acid or neutral.

This soil has rapid permeability and low available water capacity. Runoff is very slow, and organic-matter content is low. The soil is highly susceptible to soil blowing if the grass cover is removed. Moisture is easily absorbed and released readily to plants.

The main concern of management is the coarse texture of the surface layer, which makes cultivation difficult and permits leaching of plant nutrients. Maintaining fertility and controlling soil blowing also are serious concerns.

Dryland management.—This soil is not suited to dry-farmed cultivated crops, because of droughtiness and the hazard of soil blowing. It is better suited to range than to most other uses. It also is suited to trees in windbreaks, recreational development, and wildlife habitat. A few cultivated areas need reseeding to native grass.

Areas of range require proper stocking and deferred grazing to maintain a vigorous stand of grass and to control soil blowing.

Irrigation management.—Crops suited to this soil under irrigation are corn, sorghum, alfalfa, and tame grass.

This soil is not suitable for gravity methods of irrigation but can be sprinkler irrigated. Water should be applied rapidly but lightly and frequently. Using close-growing crops, leaving crop residues on the surface, and using winter cover crops help control soil blowing. Heavy applications of phosphate fertilizer and lime are needed for legumes. Nitrogen needs to be applied frequently and lightly to prevent leaching. Barnyard manure helps to maintain fertility and the organic-matter content.

CAPABILITY UNIT VIe-8, DRYLAND

This unit consists of strongly sloping to steep Coly soils and strongly sloping Uly soils that are severely eroded. These are deep, well-drained soils on loessal uplands. They have a surface layer of loam and silt loam that is mildly alkaline. Most areas are calcareous at or near the surface.

These soils have moderate permeability and high available water capacity. Runoff is rapid. The organic-matter content is low or moderately low and needs to be improved. The soils release moisture readily to plants.

These soils are highly susceptible to water erosion if they are not kept in grass or other protective cover.

Some of the strongly sloping areas are cultivated, but they are better suited to native grass used as range. These

soils also are suited to trees in windbreaks, recreational development, and wildlife habitat. Areas that are cultivated can be seeded to native grass. Proper stocking and deferred grazing help to maintain and improve stands of grass. Leaving about half the current year's growth of grass at the end of the grazing season helps maintain the organic-matter content, slows runoff, and protects the soil from erosion.

CAPABILITY UNITS VIw-5, DRYLAND, AND IVw-5, IRRIGATED

These units consist of Els and Elsmere fine sands. These are deep, nearly level to very gently sloping, somewhat poorly drained soils in Sandhill valleys. The water table fluctuates between 2 and 6 feet beneath the surface. The surface layer of fine sand is neutral to mildly alkaline.

These soils have rapid permeability and low available water capacity. Runoff is very slow. Organic-matter content is low to moderately low.

These soils are highly susceptible to soil blowing if they are cultivated. They are commonly too wet for tillage early in spring. In many places stands of grass and legumes are poor.

Dryland management.—These soils are not suited to dryland cultivation. They are better suited to use as pasture, range, or hayland. They also are suited to trees planted in windbreaks and to wildlife habitat.

Only a few areas are intensively cultivated, but many areas have poor stands of alfalfa and grass. These areas need to be seeded to native grasses. Proper stocking and deferred grazing help to maintain grass vigor and encourage the increase of deep-rooted grasses that can take advantage of the high water table. Mowing or other weed-control measures can be used. Legumes can be encouraged in meadows by using phosphate fertilizer.

Irrigation management.—These soils are suited to irrigated corn, alfalfa, forage sorghum, and tame grass.

Sprinkler irrigation is the most suitable method on these soils. Irrigation water needs to be applied frequently and lightly to prevent waterlogging and deep leaching of fertility. Soil blowing can be controlled by using a stubble-mulch system of tillage, returning crop residues to the soil, planting winter cover crops, and using close-growing crops. Barnyard manure and commercial fertilizer are needed on these soils.

CAPABILITY UNIT VIIe-7, DRYLAND

Only Rough broken land, loess, is in this unit. This land type consists of deep, very steep, loess material. It is excessively drained and occurs in canyons of the loessal uplands.

This material has moderate permeability and high available water capacity. Runoff is very rapid because only part of the rainfall enters the soil material. The organic-matter content is very low. The soil material is highly susceptible to water erosion if the grass cover is destroyed. It is difficult for livestock to graze where slopes are very steep.

Most of this land type is in range and is used for grazing. The steepness of slope makes it difficult to plant trees or develop recreational facilities. The land type is used by wildlife.

Management that maintains a good cover of grass by proper stocking and deferred grazing is the best means of reducing water erosion and conserving moisture. Proper placement of fences, water, and salt is important for the proper distribution of grazing. Stock-water dams and erosion control structures can be built in favorable locations on this land type.

CAPABILITY UNIT VIIe-5, DRYLAND

This unit consists of Blown-out land and steep to very steep soils of the Valentine series. These are excessively drained soils of the Sandhills. The soils and soil materials have a surface layer of fine sand that is slightly acid or neutral.

These soils have rapid permeability and low available water capacity. Runoff is slow, and organic-matter content is low. Blown-out land is very severely eroded, and Valentine soils are highly susceptible to soil blowing if the grass cover is damaged or destroyed.

The soils and land type in this unit are too steep for cultivation. They are best used as range, and they also are used by wildlife. Planting trees or developing recreational facilities is difficult.

Proper stocking and deferred grazing help to maintain and improve stands of grass and to control erosion. Uniform grazing can be achieved by proper placement of fences, salt, and water.

CAPABILITY UNIT VIIIw-7, DRYLAND

Only Marsh is in this unit. This land type consists of partially decomposed organic matter that is mixed with soil material, mainly fine sand. Water covers the surface during most of the year but is not deep enough to prevent the growth of cattails, rushes, and other kinds of aquatic vegetation. Marsh occurs in basins in upland valleys and in low areas adjacent to streams.

This land type is not suited to cultivated crops, to plants used for grazing, or to planted trees. It is best used as wildlife habitat.

Predicted yields

Table 2 lists the predicted average yields per acre for the principal irrigated and dryland crops grown on the soils in Logan County. Omitted from the table are soils that are not generally used for at least one of the principal crops.

The predictions in table 2 are based on information furnished by farmers and rural leaders who are familiar with the soils and farming of the county. The yields are averages over a long period of time. They take into account the years when the moisture is plentiful and years when it is not. They also indicate yields lowered by insect, disease, and hail damage. The predictions reflect the yields expected by farmers using practices common in modern farming.

The predicted yields are listed under two levels of management. Those in columns A can be expected under average management. For example, under average management for dryland crops, little or no fertilizer is applied, more erosion control practices are needed, insects and diseases are not completely controlled, and the most suitable cropping sequence is not used.

Yields in columns B can be expected under a high level of management. For example, under a high level of management for irrigated crops, fertilizer of a kind and in an amount indicated by soil tests and field experience is applied; practices that control soil blowing and water

TABLE 2.—*Predicted average acre yields of principal dryland and irrigated crops under two levels of management*

[Yields in columns A are those expected under average management; yields in columns B are those expected under a high level of management. Absence of yield indicates that crop is not grown on that soil. Yields are not given for soils that are not generally used for at least one of the principal crops]

Mapping unit	Corn				Wheat		Alfalfa hay			
	Dryland		Irrigated		Dryland		Dryland		Irrigated	
	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*
Anselmo fine sandy loam, 0 to 3 percent slopes	18	30	85	130	15	25	1. 2	1. 7	3. 5	5. 5
Anselmo fine sandy loam, 3 to 5 percent slopes	15	28	80	120	13	24	1. 0	1. 6	3. 0	5. 0
Anselmo fine sandy loam, 5 to 11 percent slopes	12	25	65	90	10	20	. 8	1. 5	2. 5	4. 0
Anselmo fine sandy loam, terrace, 0 to 1 percent slopes	20	32	85	130	15	27	1. 2	1. 9	3. 0	5. 5
Dunday-Valentine loamy fine sands, 0 to 3 percent slopes	14	23	70	110	10	20	. . 8	1. 5	2. 5	4. 0
Els and Elsmere fine sands			70	90					2. 0	3. 5
Hall silt loam	22	35	90	140	25	32	1. 5	2. 0	3. 5	6. 0
Hersh fine sandy loam, 3 to 5 percent slopes	12	25	65	100	11	22	. 8	1. 5	2. 5	4. 0
Hersh and Anselmo fine sandy loams, 0 to 3 percent slopes	15	28	80	115	13	24	1. 0	1. 6	3. 0	5. 0
Hersh and Valentine soils, 5 to 11 percent slopes	10	21			8	14	. 7	1. 5		
Hobbs silt loam, 0 to 1 percent slopes	27	37	90	140	25	35	1. 8	2. 3	4. 0	6. 5
Hobbs silt loam, 1 to 3 percent slopes	23	35	90	135	24	34	1. 7	2. 0	3. 5	6. 0
Holdrege fine sandy loam, 2 to 4 percent slopes, overblown	20	30	90	130	15	25	1. 3	1. 9	3. 3	5. 4
Holdrege silt loam, 3 to 5 percent slopes	22	32	95	125	20	29	1. 5	2. 2	3. 0	6. 0
Holdrege silt loam, 3 to 5 percent slopes, eroded	17	26	80	115	18	27	1. 5	2. 3	2. 8	5. 4
Holdrege silt loam, 5 to 11 percent slopes	17	26	75	95	17	24	1. 3	1. 8	2. 4	5. 4
Holdrege silt loam, 5 to 11 percent slopes, severely eroded	12	25	70	90	13	22	1. 0	1. 5	2. 3	5. 3
Holdrege-Hord silt loams, 0 to 3 percent slopes	25	35	100	135	25	34	1. 7	2. 2	4. 0	6. 5
Hord silt loam, 0 to 1 percent slopes	27	38	105	140	25	35	1. 8	2. 3	4. 0	6. 5
Hord silt loam, 1 to 3 percent slopes	25	36	95	135	24	34	1. 7	2. 2	3. 5	6. 2
Hord silt loam, 3 to 5 percent slopes	23	33	90	125	23	33	1. 7	2. 0	3. 0	6. 0
Ord fine sandy loam	20	30	60	97	20	25	1. 7	2. 5	3. 0	4. 5
Ord fine sandy loam, alkali	12	20	50	80	12	20	1. 4	2. 3	2. 0	4. 0
Ovina fine sandy loam	16	29	60	110	14	23	1. 5	2. 0	2. 5	5. 0
Scott soils	15	25			10	20				
Uly silt loam, 0 to 2 percent slopes	20	30	80	130	20	29	1. 5	2. 0	3. 0	6. 0
Uly-Holdrege silt loams, 5 to 11 percent slopes	13	25	70	95	16	24	1. 0	1. 5	2. 2	5. 0
Valentine fine sand, nearly level			50	80					2. 0	3. 5
Valentine loamy fine sand, nearly level	13	22	60	100	10	18	. 8	1. 3	2. 4	4. 0
Vetal fine sandy loam	20	35	85	130	20	35	1. 2	1. 8	3. 0	5. 5

erosion are used; approved methods of tilling, planting, and irrigation are used; adapted crop varieties are planted at the proper rate; weeds, insects, and disease are controlled; a suitable cropping sequence is used to maintain tilth and organic-matter content; and all practices are performed at the proper time.

Wheat yields were based on planted acres. Most of the wheat is harvested on soils that were summer fallowed the year before. On sandy soils it is difficult to do a complete job of fallow without soil blowing, and wheat yields on sandy soils reflect a lower degree of fallow and, in some cases, no fallow at all.

Use of the Soils for Range [4]

Approximately 86 percent of the total farmland in Logan County is in range. The soils used as range generally are not suitable for cultivation. The largest areas of rangeland are in the Valentine and Valentine-Dunday soil associations.

The raising of livestock, mainly cow-calf herds, is the largest farm industry in the county. The calves are sold in the fall as feeders.

Range sites and condition classes

Different kinds of range produce different kinds and amounts of native vegetation. For proper range management, an operator should know the different kinds of land or range sites in his holding and the native plants each site can grow. Management that favors the growth of the best forage plants on each kind of soil can then be used.

Range sites differ from each other in their ability to produce a significantly different kind, proportion, or amount of climax, or original, vegetation. A significant difference is one great enough to require some variation in management, such as a different stocking rate. Climax vegetation is the combination of plants that originally grew on a given site. The most productive combination of range plants on a site generally is the climax type of vegetation.

Range condition is classified according to the percentage of original, or climax, vegetation on the site. This classification is used for comparing the kind and amount of present vegetation with that which the site can pro-

[4] By PETER N. JENSEN, range conservationist, Soil Conservation Service.

duce. Changes in range condition are caused primarily by the intensity of grazing and by drought.

Vegetation is altered by intensive grazing. Livestock graze selectively. They seek the more palatable and nutritious plants. Plants react to grazing in one of three ways—by decreasing, increasing, or invading. Decreaser and increaser plants are climax plants. Generally, *decreasers* are the most heavily grazed and, consequently, the first to be injured by overgrazing. *Increasers* withstand grazing better or are less palatable to the livestock. They increase under grazing and replace the decreasers. *Invaders* are weeds that become established after the climax vegetation has been reduced by grazing.

Range condition is expressed in four condition classes that show the present state of the vegetation on a range site in relation to the vegetation that grew on it originally. The condition is *excellent* if 76 to 100 percent of the vegetation is climax; *good* if 51 to 75 percent is climax; *fair* if 26 to 50 percent is climax; and *poor* if 0 to 25 percent is climax.

Management practices that maintain or improve the condition of the range are needed on all rangeland in the county. These practices are (1) proper range use (fig. 16), (2) deferred grazing, and (3) planned grazing systems. The distribution of livestock in a pasture can be improved by correctly locating fences, livestock water, and salt.

In many places the condition of the range can be improved by range seeding. This improvement can be obtained by seeding or reseeding grasses of either wild or improved strains on soils suitable for range. Anselmo fine sandy loam, 5 to 11 percent slopes, and Hersh and Valentine soils, 5 to 11 percent slopes, are examples of soils that still are cropped but should be seeded to grasses.

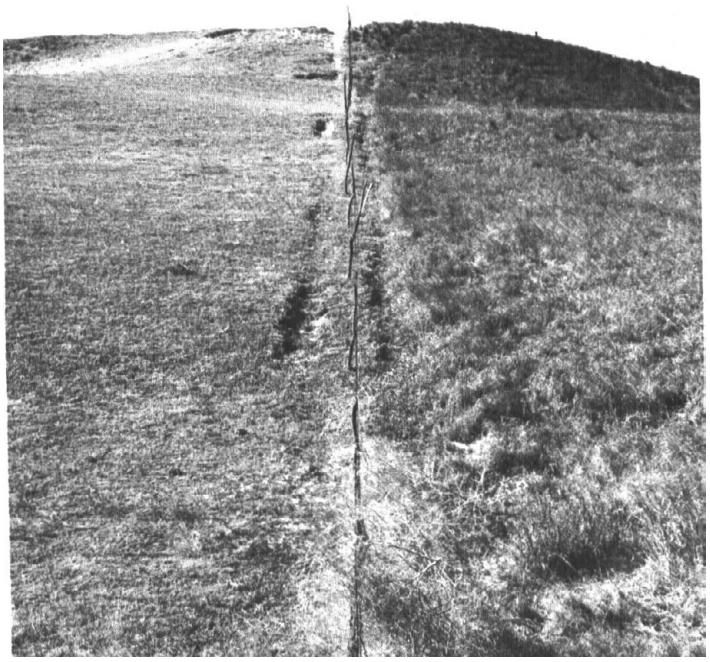


Figure 16.—Fence-line contrast on Valentine loamy fine sand, rolling. Overused range is on the left.

Among the grasses that are suitable for seeding on these soils are sand bluestem, little bluestem, indiangrass, switchgrass, prairie sandreed, and sand lovegrass. No care other than management of grazing is needed to maintain forage composition if proper vegetation is established.

The native meadows in Logan County are mostly limited to the Wet Land and Subirrigated range sites, on such soils as Els and Elsmere fine sands, Gannett fine sandy loam, and Wet alluvial land (fig. 17).

The range sites in Logan County are classified as Wet Land, Subirrigated, Clayey Overflow, Sandy Lowland, Silty Lowland, Sandy, Sands, Choppy Sands, Silty, Limy Upland, and Thin Loess (fig. 18). These range sites are described in this section. The descriptions include (1) the topography in each site, (2) the soils in each site, (3) the dominant vegetation of the site when in excellent condition, (4) the dominant vegetation on this site in a lower range condition, and (5) the total annual yield in pounds per acre, air-dry weight, when site is in excellent condition. The range site for each mapping unit is shown in the "Guide to Mapping Units" (fig. 19).

WET LAND RANGE SITE

Wet alluvial land is the only mapping unit in this site. It is nearly level, is very poorly drained, and occurs adjacent to lakes, marshes, and some streams. The soil material is deep and consists of alternate layers of silt, sand, and organic matter.

The high water table and ponded surface make this land type too wet for haying in some years. Bogs are common in grazed areas. Although the quantity of vegetation is large, it is difficult to maintain a stand of palatable plants. Areas of this land are difficult to drain, but some hay meadows have been improved by installing V-ditches to speed surface drainage.

At least 70 percent of the climax plant cover is a mixture of such decreaser grasses as prairie cordgrass and reedgrasses. Other perennial grasses and forbs make up the rest. Members of the sedge family are the principal increasers. If the site is in poor condition, the typical plant community consists of Kentucky bluegrass, redtop, and sparse amounts of prairie cordgrass and sedges.

If the site is in excellent condition, the total annual yield of air-dry forage ranges from 6,000 pounds per acre in unfavorable years to 7,000 pounds in favorable years.

SUBIRRIGATED RANGE SITE

This site consists of deep, nearly level to very gently sloping soils of the Els, Elsmere, Gannett, Loup, Ord, and Tryon series. These are poorly drained and somewhat poorly drained soils on bottom lands, on stream terraces, and in upland valleys. In the valleys the water table ranges from the surface to a depth of 6 feet. The soils in this site have a surface layer of fine sandy loam, loamy fine sand, or fine sand. Reaction in the surface layer ranges from neutral to moderately alkaline, except that in some areas Ord soils are strongly alkaline and in some areas Loup soils are slightly acid.

Permeability ranges from moderate to rapid. The organic-matter content is low to high. The available water capacity is low to moderate, but in many areas this is not important because the water table is high.

Figure 17.—**Native hay meadow on Wet alluvial land. This is in the Wet Land range site.**

At least 75 percent of the climax plant cover is a mixture of such decreaser grasses as big bluestem, little bluestem, indiangrass, switchgrass, prairie cordgrass, and Canada wildrye. Other perennial grasses and forbs make up the rest. Western wheatgrass and members of the sedge family are the principal increasers.

If the site is in poor range condition, the typical plant community consists of Kentucky bluegrass, foxtail barley, redtop, blue verbena, and small amounts of western wheatgrass and sedges.

If the site is in excellent condition, the total annual yield of air-dry forage ranges from 5,000 pounds per acre in unfavorable years to 6,000 pounds in favorable years.

CLAYEY OVERFLOW RANGE SITE

Only Scott soils are in this site. These are deep, nearly level, poorly drained soils in upland depressions. The surface layer of silt loam is slightly acid.

Permeability is slow, and water commonly covers the surface for long periods after rains. The soils have a high available water capacity. They are not susceptible to water erosion, but soil blowing can occur if the vegetative cover is removed.

At least 60 percent of the climax plant cover is a mixture of such decreaser grasses as big bluestem, little bluestem, indiangrass, switchgrass, and Canada wildrye. Other perennial grasses and forbs make up the rest. Blue grama, western wheatgrass, and sedges are the principal increasers.

If the site is in poor range condition, the typical plant community consists of western ragweed, Baldwin ironweed, blue verbena, annuals, and buffalograss.

If the site is in excellent condition, the total annual yield of air-dry forage ranges from 3,500 pounds per acre in unfavorable years to 4,500 pounds in favorable years.

SANDY LOWLAND RANGE SITE

Only Ovina fine sandy loam is in this site. This is a moderately well drained soil on stream terraces and high bottom lands. It has a surface layer of fine sandy loam that is slightly acid to mildly alkaline.

Permeability is moderately rapid, and available water capacity is moderate. Runoff is slow to medium. The soil is slightly susceptible to water erosion and moderately susceptible to soil blowing.

At least 75 percent of the climax plant cover is a mixture of such decreaser grasses as sand bluestem, indiangrass, switchgrass, little bluestem, porcupinegrass, and Canada wildrye. Other perennial grasses and forbs make up the rest. Prairie sandreed, sand dropseed, western wheatgrass, and members of the sedge family are the principal increasers.

If the site is in poor range condition, the typical plant community consists of sand dropseed, Scribner panicum, blue grama, western ragweed, and blue verbena.

If the site is in excellent condition, the total annual yield of air-dry forage ranges from 3,500 pounds per acre in unfavorable years to 4,000 pounds in favorable years.

SILTY LOWLAND RANGE SITE

This site consists of nearly level to very gently sloping soils in the Hobbs series and nearly level soils in the Hall and Hord series. These soils are deep and well drained and are in drainageways, swales, and flats of the loessal uplands. They have a surface layer of silt loam that is slightly acid or neutral.

Permeability is moderate or moderately slow. Available water capacity is high. Runoff is slow on all soils except the very gently sloping Hobbs, where it is medium.

At least 70 percent of the climax plant cover is a mixture of such decreaser grasses as big bluestem, little blue-

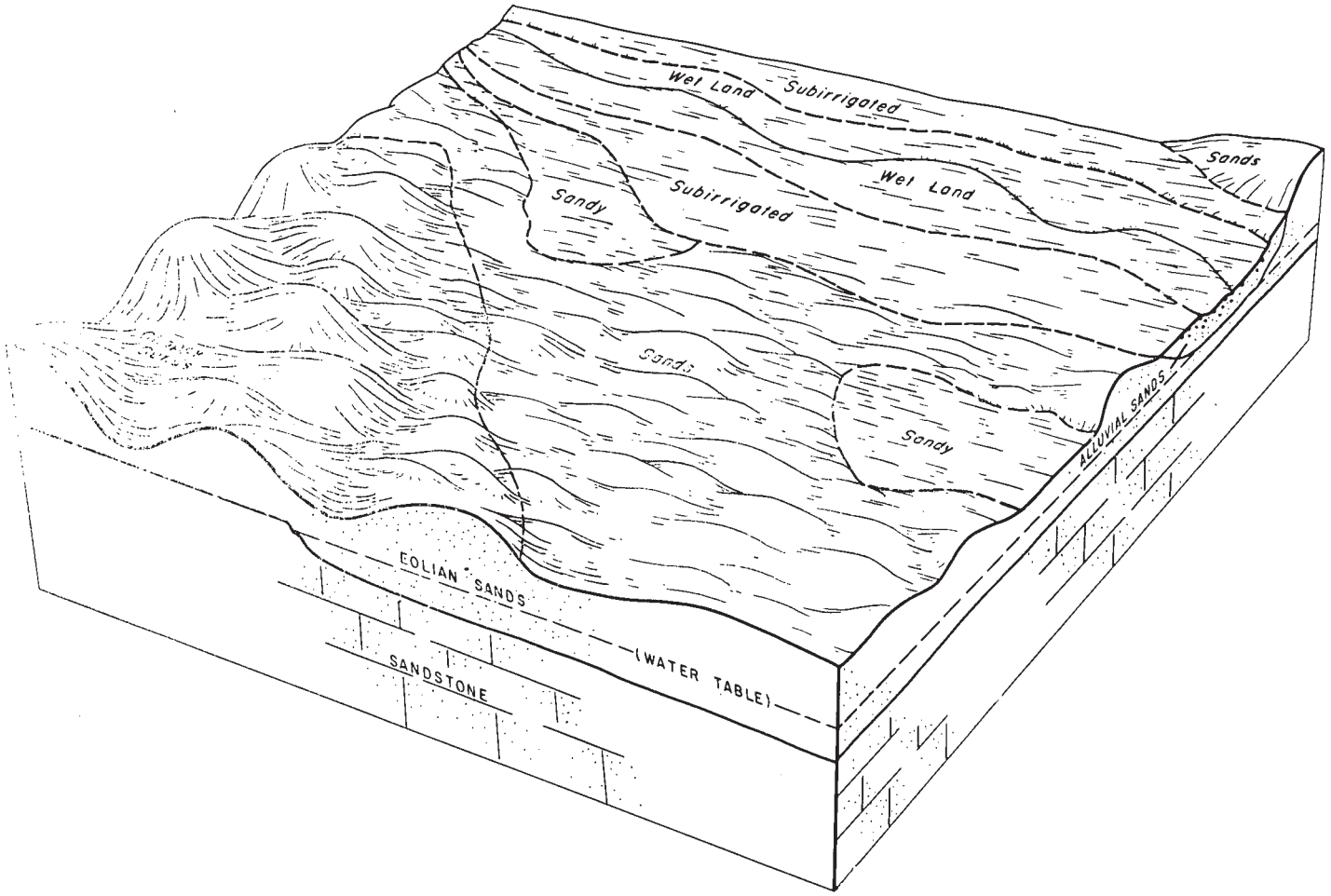


Figure 18.—**Distribution of range sites in typical sandyland landscape in Logan County.**

stem, switchgrass, side-oats grama, and Canada wildrye. Other perennial grasses and forbs make up the rest. Western wheatgrass, needle-and-thread, blue grama, and members of the sedge family are the principal increasers.

If the site is in poor range condition, the typical plant community consists of Kentucky bluegrass, sedges, western ragweed, and various annual grasses.

If the site is in excellent condition, the total annual yield of air-dry forage ranges from 3,000 pounds per acre in unfavorable years to 4,000 pounds in favorable years.

SANDY RANGE SITE

In this site are deep, nearly level to steep Anselmo, Hersh, Holdrege, and Vetal soils that have a fine sandy loam surface layer. Also in the site are nearly level to very gently sloping Dunday and Valentine soils that have a loamy fine sand or fine sand surface layer. These soils are on stream terraces and uplands and in upland valleys. The surface layer is slightly acid or neutral in reaction. These are well-drained soils, except for the Dunday, which are somewhat excessively drained, and the Valentine, which are excessively drained.

Permeability is moderately rapid to rapid, except in the Holdrege soil, where it is moderate. Available water capacity is moderate to low, except for the Holdrege soil, which has a high capacity. Runoff is very slow to medium. Organic-matter content is low to moderate. All the soils are moderately to highly susceptible to soil blowing if there is no protective cover.

At least 50 percent of the climax plant cover is a mixture of such decreaser grasses as little bluestem, indiangrass, sand bluestem, and switchgrass. Other perennial grasses and forbs make up the rest. Needle-and-thread, prairie sandreed, blue grama, sand dropseed, and western wheatgrass are the principal increasers. Blue grama, sand dropseed, Scribner panicum, sand paspalum, and western wheatgrass are the last climax grasses to disappear in a deteriorated range.

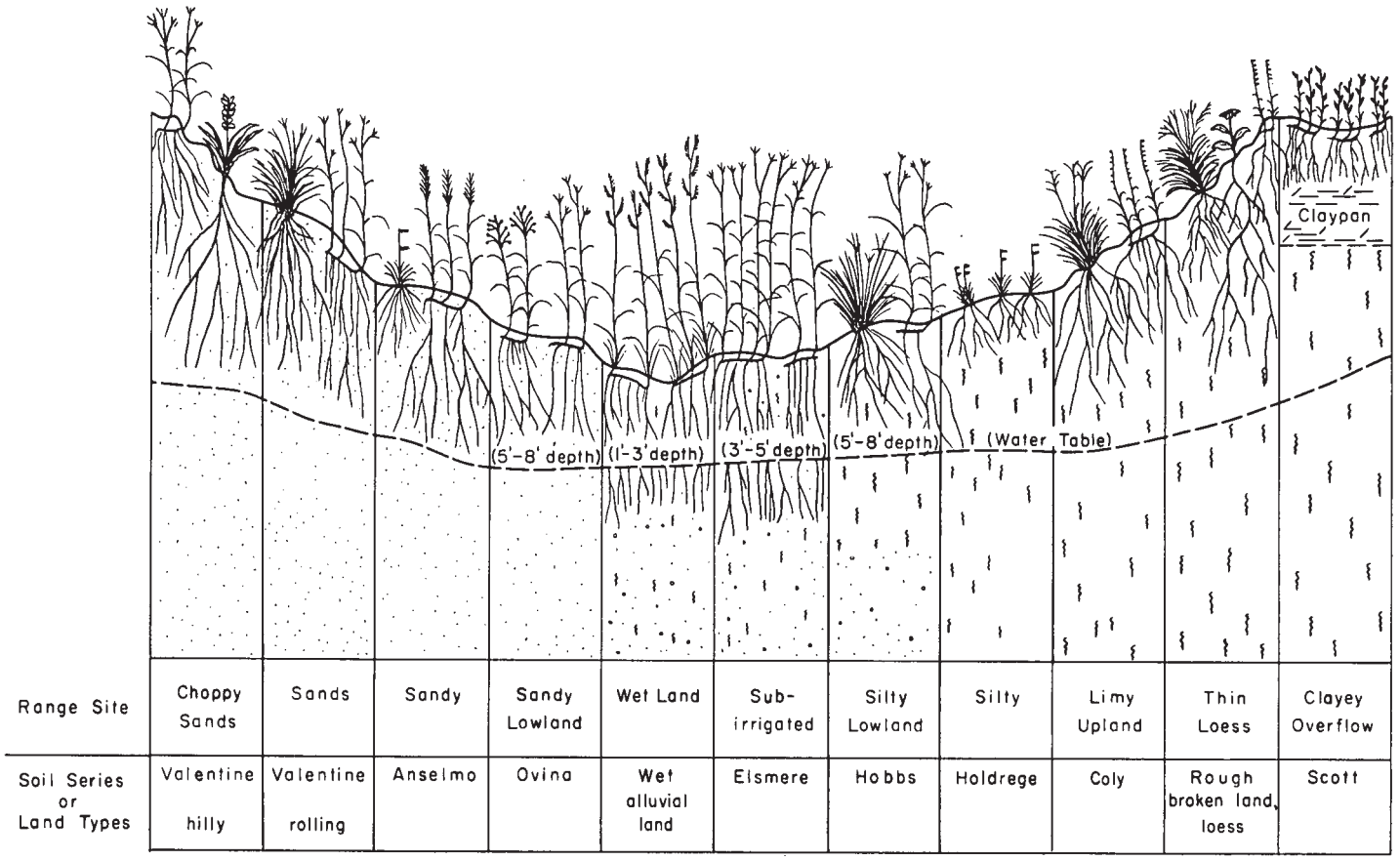
If the site is in poor range condition, the typical plant community consists of blue grama, sand dropseed, sand paspalum, windmillgrass, tumblegrass, annual bromes, and western ragweed.

If the site is in excellent condition, the total annual yield of air-dry forage ranges from 2,500 pounds per acre in unfavorable years to 3,500 pounds in favorable years.

SANDS RANGE SITE

This site consists of deep, gently sloping to very steep soils of the Dunday and Valentine series and Blown-out land. These are somewhat excessively to excessively

LOGAN COUNTY RANGE SITES AND REPRESENTATIVE SOILS



Range Site	Choppy Sands	Sands	Sandy	Sandy Lowland	Wet Land	Sub-irrigated	Silty Lowland	Silty	Limy Upland	Thin Loess	Clayey Overflow
Soil Series or Land Types	Valentine hilly	Valentine rolling	Anselmo	Ovina	Wet alluvial land	Elsmere	Hobbs	Holdrege	Coly	Rough broken land, loess	Scott

Figure 19.—**Logan County range sites and representative soils.**

drained soils on uplands of the Sandhills. These soils have a surface layer of loamy fine sand or fine sand that is slightly acid or neutral.

Permeability is rapid, and available water capacity is low. Runoff is slow, and the organic-matter content is low or moderately low, except in Blown-out land, where it is very low. These soils are highly susceptible to soil blowing if the grass cover is destroyed. The hazard of water erosion is slight.

At least 65 percent of the climax plant cover is a mixture of such decreaser grasses as indiangrass, sand bluestem, sand lovegrass, switchgrass, prairie junegrass, and Canada wildrye. Other perennial grasses and forbs make up the rest. Blue grama, hairy grama, little bluestem, needle-and-thread, prairie sandreed, sand dropseed, and members of the sedge family are the principal increasers.

If the site is in poor range condition, the typical plant community consists of sand dropseed, hairy grama, sandhill muhly, western ragweed, and annuals.

If the site is in excellent condition, the total annual yield of air-dry forage ranges from 2,000 pounds per acre in unfavorable years to 3,000 pounds in favorable years.

CHOPPY SANDS RANGE SITE

This site consists of Valentine fine sand, hilly, and the hilly part of Valentine complex, hilly. These are excessively drained soils on dunelike terrain. They have a surface layer of fine sand that is slightly acid. Catsteps are a common feature of this site (see fig. 13 on p. 25).

Permeability is rapid. Available water capacity and organic-matter content are low. Runoff is slow. These soils are highly susceptible to erosion if the grass cover is damaged or destroyed.

At least 70 percent of the climax plant cover is a mixture of such decreaser grasses as blowoutgrass, sand bluestem, sand lovegrass, switchgrass, and decreaser forbs and woody plants. Other perennial grasses and forbs make up the rest. Little bluestem, prairie sandreed, hairy grama, sand dropseed, sand paspalum, and members of the sedge family are the principal increasers. The principal forbs and woody increasers are small soapweed, Arkansas rose, lemon scurfpea, and skeletonplant. Generally, the range condition is good or excellent.

If the site is in excellent condition, the total annual yield of air-dry forage ranges from 2,000 pounds per acre in unfavorable years to 2,500 pounds in favorable years.

SILTY RANGE SITE

This site consists of deep, nearly level to steep soils of the Holdrege, Hord, and Uly series and the steep part of Rough broken land, loess. These are well-drained and excessively drained soils on stream terraces and loessal uplands. They have a surface layer of silt loam that is slightly acid to mildly alkaline.

These soils have moderate permeability and high available water capacity. Runoff is medium to rapid. They are slightly to highly susceptible to water erosion. The organic-matter content is low or moderate.

At least 65 percent of the climax plant cover is a mixture of such decreaser grasses as big bluestem, little bluestem, indiangrass, and switchgrass. Other perennial grasses and forbs make up the rest. Blue grama, buffalograss, side-oats grama, and western wheatgrass are the principal increasers.

If the site is in poor range condition, the typical plant community consists of blue grama, buffalograss, western ragweed, red threeawn, and annuals.

If the site is in excellent condition, the total annual yield of air-dry forage ranges from 2,500 pounds per acre in unfavorable years to 3,500 pounds in favorable years.

LIMY UPLAND RANGE SITE

This site consists of deep, strongly sloping to steep soils of the Coly series. These are well-drained soils on loessal uplands. They have a surface layer of loam or silt loam that is neutral to moderately alkaline.

These soils are moderately permeable and have high available water capacity. Organic-matter content is low. Some of these soils are severely eroded; they are very highly susceptible to water erosion if the grass cover is destroyed.

At least 65 percent of the climax plant cover is a mixture of such decreaser grasses as big bluestem, little bluestem, switchgrass, indiangrass, side-oats grama, and plains muhly. Other perennial grasses and forbs make up the rest. Blue grama and buffalograss are the principal increasers.

If the site is in poor range condition, the typical plant community consists of blue grama, buffalograss, western ragweed, red threeawn, and annuals.

If the site is in excellent condition, the total annual yield of air-dry forage ranges from 1,750 pounds per acre in unfavorable years to 2,500 pounds in favorable years.

THIN LOESS RANGE SITE

Only the very steep part of Rough broken land, loess, is in this site. This part is commonly characterized by catstep terrain. It consists of deep, excessively drained, loess material on the sides of canyons in uplands.

Permeability is moderate, and available water capacity is high. Runoff is very rapid. Because of the very steep slopes, the hazard of water erosion is severe if the grass cover is destroyed.

At least 75 percent of the climax plant cover is a mixture of such decreaser grasses as little bluestem, big bluestem, side-oats grama, switchgrass, and plains muhly. Other perennial grasses and forbs make up the rest. Blue grama, sand dropseed, and western wheatgrass are the principal increasers.

If the site is in poor range condition, the typical plant community consists of blue grama, sand dropseed, broom snakeweed, and various annuals.

If the site is in excellent condition, the total annual yield of air-dry forage ranges from 1,500 pounds per acre in unfavorable years to 2,250 pounds in favorable years.

Use of the Soils for Woodland and Windbreaks [5]

The native trees in Logan County grow only on bottom lands along the South Loup River and its tributaries. American elm, hackberry, cottonwood, willow, green ash, plum, eastern redcedar, and boxelder grow naturally there. Other trees and shrubs used in windbreaks have been introduced from other areas. Eastern redcedar grows sparsely on Rough broken land, loess, and on soils in the southern part of the county. Because of the small number and limited growth of the trees, natural woodland in Logan County has little commercial value. Early settlers planted trees for shade and fence posts and to protect their homes. Throughout the years, landowners have continued to plant trees to protect buildings, livestock, and soil. Native trees and shrubs contribute a great deal to the natural beauty of the landscape in Logan County. Their presence benefits wildlife by producing food and cover.

One of the most important uses for trees in Logan County is for windbreaks. Because of the scarcity of native trees and the severe extremes of weather that prevail, windbreaks are needed for farmstead and livestock protection. The landowner who plants a windbreak is well paid for his time and expense. Windbreaks help to reduce home heating costs, control snow drifting, provide shelter for livestock, improve conditions for wildlife, and beautify the home and countryside.

Windbreak planting and care

Although trees are not easily established in the county, observing basic rules of tree culture can result in a high degree of tree survival. Healthy seedlings, properly planted on a prepared site and maintained in good condition, can survive and grow well. Plantings should be cultivated for 4 or 5 years in order to control weeds and prevent competition for moisture. This can be done by using mechanical implements or chemical weed killers. Trees on soils in the Very Sandy windbreak suitability group, however, need to be planted in a wide, shallow furrow and not cultivated, because the hazard of erosion is too high. Another exception is where the water table interferes with cultivation on soils of the Moderately Wet and Very Wet windbreak suitability groups. Trees generally are planted in a furrow. They need protection from livestock and fire, and when they are seedlings, from rabbits and mice. Additional information on the design, planting, and care of windbreaks is available from the Soil Conservation Service and the Extension Service forester serving the county.

Table 3 gives the expected height, at 20 years of age, for trees suitable for windbreaks in Logan County. Detailed tree measurements were taken on soils of the major windbreak suitability groups in Logan County. The soils in each group are listed in the description of

[5] By JAMES W. CARR, Jr., forester, Soil Conservation Service.

TABLE 3.—*Relative vigor and estimated height of specified trees at 20 years of age, by windbreak suitability group*

[Very Wet, Moderately Saline-alkali, and Undesirable windbreak suitability groups are not included, because windbreaks are generally not needed on soils of these groups in Logan County. Dashes indicate sufficient data not available]

Species	Silty to Clayey group		Sandy group		Very Sandy group		Moderately Wet group	
	Relative vigor	Average height	Relative vigor	Average height	Relative vigor	Average height	Relative vigor	Average height
		Feet		*Feet*		*Feet*		*Feet*
American plum	Good	8	Good	8				
Chokecherry	Good		Excellent	7			Fair	(1)
Cottonwood	Poor	(1)	Good	45			Good	47
Eastern redcedar	Excellent	17	Excellent	17	Excellent	15	Excellent	16
Green ash	Good	21	Good	22	Poor	(1)	Good	24
Hackberry	Good	19	Good	18	Poor	(1)	Fair	(1)
Honeylocust	Good	24	Good	23	Fair	(1)	Good	19
Ponderosa pine	Excellent	22	Excellent	22	Excellent	25	Poor	(1)
Russian-olive	Fair	18	Fair	19			Poor	(1)
Siberian elm [2]	Good	30	Good	34	Good	31	Good	25
Boxelder	Fair	(1)	Good	21	Good	19	Excellent	19

[1] Majority of trees dead or dying.

[2] Not recommended for planting.

the group. Soils in each group have similar characteristics that affect tree growth.

Suitability ratings in table 3 are based upon observations of general vigor and condition of the trees. A rating of *excellent* indicates that the trees are growing well, the leaves have good color, there are no dead branches in the upper part of the crown, and there is no indication of damage by fungi or insects. A rating of *good* indicates that the trees are growing moderately well, there are only a few dead branches and some dieback in the upper part of the crown, and there is a slight indication of damage by fungi or insects. A rating of *fair* indicates that at least half of the trees have a significant number of dead branches in the upper part of the crown, and about one-fourth of the trees are dead. Growth has slowed significantly, and there are indications of moderate damage by fungi or insects. A rating of *poor* indicates that the remaining living trees have severe dieback, more than one-fourth of the trees in the stand are dead, and there are indications of severe damage by fungi or insects.

Eastern redcedar and ponderosa pine are best suited to use in windbreaks. Measurements show that these conifers, both native to Nebraska, are the most reliable species for windbreaks. Both rated high in survival and vigor in the studies made. They hold their leaves through the winter and thereby give maximum protection when it is most needed.

Table 3 also shows several broadleaf species that are well suited to use in windbreaks of Logan County. The best broadleaf species, according to the results of the study, are honeylocust, green ash, hackberry, and Siberian elm. Shrubs that stand the test of time are American plum and chokeberry. The windbreak study showed that eastern redcedar can be expected to grow slightly less than 1 foot in height per year. It appears that eastern redcedar can reach a mature height of 25 to 30 feet. Ponderosa pine grows slightly more rapidly and will probably be somewhat taller at maturity. The same is true of broadleaf trees.

Rate of growth in a windbreak varies widely with soil moisture conditions. Soil fertility, exposure, and arrangement of species within the planting have a marked effect on growth. Some species grow more rapidly than others; some make an early fast growth but tend to die young. This is sometimes true of cottonwood. Siberian elm and Russian-olive are vigorous early growers, but they can spread to areas where they are not wanted, and are short lived. Boxelder and mulberry commonly freeze back in severe winters, and green ash is susceptible to damage by borers.

Windbreak suitability grouping

Soils of Logan County are grouped according to the characteristics that affect tree growth. The soil series represented in the windbreak suitability groups are named in the descriptions of the group, but this does not mean that all of the soils of a given series appear in that group. To find the names of all the soils in any group, refer to the "Guide to Mapping Units" at the back of this survey. Soils in each group produce similar growth and survival of trees under normal conditions of weather and care. The following is a brief description of the windbreak suitability groups in Logan County, including a list of trees and shrubs that are suitable for windbreak plantings in each group.

SILTY TO CLAYEY WINDBREAK SUITABILITY GROUP

This group consists of deep, nearly level to steep soils of the Coly, Hall, Hobbs, Holdrege, Hord, and Uly series. These are well-drained soils on uplands. They have a surface layer of loam or silt loam that ranges from slightly acid to moderately alkaline in reaction.

The soils are moderately to moderately slowly permeable. The available water capacity is high. Runoff is slow to rapid. The hazard of water erosion ranges from slight to severe, depending primarily on the soil slope.

These soils generally provide good sites for planted trees, and the survival and growth of adapted species are good. Drought and competition from weeds and grasses for moisture are the principal hazards. Water erosion is a hazard on the gently sloping to steep soils.

Trees and shrubs suitable for planting are the *conifers*, eastern redcedar, Rocky Mountain juniper, ponderosa pine, Austrian pine, Scotch pine; the *hardwoods*, Russian-olive, honeylocust, green ash, and hackberry; and the *shrubs*, cotoneaster, honeysuckle, lilac, and chokecherry.

SANDY WINDBREAK SUITABILITY GROUP

This group consists of deep, nearly level to steep soils of the Anselmo, Dunday, Hersh, Holdrege, Ovina, Valentine, and Vetal series. These soils are well drained to excessively drained. The surface layer ranges from slightly acid to mildly alkaline. It is fine sandy loam in all the soils except the Dunday and Valentine, which have a surface layer of loamy fine sand.

Soils in this group are moderately to rapidly permeable. The available water capacity is moderate to high, except in the Dunday and Valentine soils, where it is low. Runoff is very slow to medium. These soils are highly susceptible to soil blowing if they are cultivated.

These soils are suited to tree planting if soil blowing is controlled by maintaining strips of sod or other vegetation between the rows. Drought and competition for moisture from grass and weeds are hazards. Water erosion can be a hazard on the gently to moderately sloping soils. Trees and shrubs suitable for planting are the *conifers*, eastern redcedar, Rocky Mountain juniper, ponderosa pine, Austrian pine, and Scotch pine; the *hardwoods*, honeylocust and green ash; and the *shrubs*, skunkbush sumac, cotoneaster, lilac, chokecherry, and western sandcherry.

VERY SANDY WINDBREAK SUITABILITY GROUP

This group consists of deep, nearly level to very steep soils of the Dunday and Valentine series and Blown-out land. These are somewhat excessively drained to excessively drained soils on uplands. They have a surface layer of loamy fine sand or fine sand that is slightly acid or neutral in reaction.

These soils are rapidly permeable. The available water capacity is low. Runoff is slow. The soils are highly susceptible to soil blowing if the grass cover is removed.

The soils in this group are so loose that trees need to be planted in shallow furrows and not cultivated. Young seedlings can be damaged by high winds and can be covered by drifting sand. The only trees suitable for planting on these soils are the *conifers*, eastern redcedar and ponderosa pine.

MODERATELY WET WINDBREAK SUITABILITY GROUP

This group consists of deep, nearly level to very gently sloping soils of the Els, Elsmere, and Ord series that are not affected by alkali. These are somewhat poorly drained soils in valleys of the Sandhills and on stream terraces. They have a surface layer of fine sandy loam, loamy fine sand, or fine sand that ranges from neutral to moderately alkaline in reaction.

These soils are moderately rapidly to rapidly permeable. The available water capacity is low to moderate. Runoff is slow to very slow. The soils are susceptible to blowing if the grass cover is removed.

These are good soils for tree planting if the species selected are those that can tolerate occasional wetness. Establishing trees and cultivation between the rows can be difficult in wet years. The abundant and persistent herbaceous vegetation that grows in the tree rows is a concern because it competes with the trees. Trees and shrubs suitable for planting are the *conifers*, eastern redcedar and Scotch pine; the *hardwoods*, honeylocust, green ash, cottonwood, golden willow, and white willow; and the *shrubs*, red-osier dogwood, buffaloberry, and chokecherry.

VERY WET WINDBREAK SUITABILITY GROUP

This group consists of deep, nearly level soils in the Gannett, Loup, and Tryon series and Wet alluvial land. These soils occur in valleys of the Sandhills and on stream terraces. They are generally poorly drained soils that have a high water table. Wet alluvial land is very poorly drained. The surface layer is fine sandy loam or loamy fine sand.

These soils are moderately to rapidly permeable. Runoff is very slow or ponded. The soils are only slightly susceptible to erosion.

Only those trees and shrubs that are tolerant of a high water table are suited. Trees and shrubs for planting are the *hardwoods*, cottonwood, golden willow, and white willow; and the *shrub*, red-osier dogwood.

MODERATELY SALINE OR ALKALI WINDBREAK SUITABILITY GROUP

The only mapping unit in this group is Ord fine sandy loam, alkali. This somewhat poorly drained soil is on high bottoms and stream terraces. It is deep and nearly level to very gently sloping. The surface layer of fine sandy loam is moderately to strongly alkaline.

This soil is moderately rapidly permeable. The subsoil has a strong alkali layer. The available water capacity is moderate, and runoff is slow. Soil blowing is a hazard if the cover is removed.

Establishment of trees can be difficult during wet years. Cultivation between the rows can be a concern because of wetness. Root growth is impeded by the alkali layer. Trees that can tolerate a moderate concentration of salts or alkali and can be used on this site are the *conifers*, eastern redcedar and Rocky Mountain juniper; the *hardwoods*, green ash, honeylocust, cottonwood, and Russian-olive; and the *shrub*, buffaloberry.

UNDESIRABLE WINDBREAK SUITABILITY GROUP

This group consists of Scott soils, Marsh, and Rough broken land, loess. These soils and land types vary widely in texture and other properties. They are too wet or too steep for the satisfactory establishment of trees. Scott soils are poorly drained, have a claypan, and occur in upland depressions that are frequently flooded.

The soils and land types in this group generally are not suitable for planting windbreaks of any kind. Some areas can be used for recreational and wildlife plantings of tolerant trees and shrubs if they are planted by hand or are planted by other special approved practices.

Use of the Soils for Wildlife and Recreation [6]

In this section, fish and other wildlife in Logan County are discussed in relation to the soils, vegetation, and land

[6] By Robert J. Lemaire, conservation biologist, and James W. Carr, Jr., forester, Soil Conservation Service.

use. The soils of Logan County are presently producing suitable habitats for many kinds of wildlife. A few species, such as buffalo, elk, and wolves, are no longer present.

The more important kinds of game animals and birds in the county are deer, antelope, sharp-tailed grouse, prairie chicken, and pheasant. Both mule deer and white-tailed deer live in the county, but mule deer are more than twice as numerous as white-tailed deer. Antelope were stocked in 1960 to augment the small native population. Other mammals in the county are raccoon, opossum, weasels, mink, muskrat, beaver, coyote, skunks, porcupine, badger, bobcat, jackrabbit, cottontail rabbit, fox squirrels, and fox. Waterfowl, other water birds, and furbearers use ponds, streams, and marshes in the county. Many species of land birds occur in the county during various seasons of the year, and some remain in the county throughout the year. Woody habitat for wild birds and mammals occurs along natural watercourses and in farmstead and livestock windbreaks. Snakes are not uncommon and include the prairie rattlesnake. The two permanent natural lakes in the county are highly alkaline and very shallow and are devoid of fish. The South Loup River, in the southeastern part of the county, provides suitable habitat for a few game fish and several nongame species.

The kinds and amounts of wildlife that can be supported in the county depend largely on the kind, amount, and distribution of vegetation that the soils produce, and on the management or use of that vegetation. Birds and mammals are generally more plentiful where soils are fertile and food abundant than where soils are less productive. Streams or lakes fed by water from fertile soils have potential to produce more fish than streams and lakes fed by water drained from infertile soils.

Relief affects wildlife through its influence on land use. Rough, steep areas present hazards to livestock and are impractical to cultivate for crops. Undisturbed vegetation in these areas is valuable for wildlife. Where such cover is lacking, it commonly can be developed.

Permeability and rate of water infiltration are important soil characteristics in constructing ponds for fish and in developing and maintaining wetland habitat for waterfowl. Marsh areas are suited to the development of aquatic and semi-aquatic habitat and to some species of furbearers.

Principal wildlife in soil associations

Records kept on the number of deer killed by hunters in the county indicate that there was an average of 1½ deer per section of land in the fall of 1967. Deer are plentiful, particularly white-tailed deer, along the South Loup River in the Gannett-Elsmere association. Waterfowl also are plentiful along this river.

Most of the range suitable for antelope is in the Valentine and the Valentine-Dunday soil associations. Aerial inventories reveal an average of one antelope per 2½ sections of land in these associations in 1967.

Sharp-tailed grouse are well distributed throughout all associations except the Holdrege-Hord association in the southern part of the county. Available data indicate that the average number of grouse in the county is probably between five and 20 per section. Prairie chickens are not so numerous as sharp-tailed grouse and are most common in the southern third of the county. The grain crops in this part of the county contribute importantly to the diet of this game bird.

The southern third of Logan County is also the best pheasant range in the county. This is largely for the reason that areas used for crops in the Hord-Holdrege, Ovina-Anselmo, and Valentine-Hersh associations are intermingled with some noncultivated areas of the Uly-Hersh-Coly and Gannett-Elsmere associations. Pheasants are not so common in the Valentine association in the northern two-thirds of the county. Logan County is on the extreme edge of the bobwhite quail range in Nebraska, but quail are seen and heard along the South Loup River in and near the Ovina-Anselmo association.

In addition to game birds and mammals, many kinds of nongame wildlife are present in the county. Such predators as coyotes, fox, hawks, and owls are beneficial in helping to control undesirable rodents. Consuming harmful insects and weed seeds is a contribution of songbirds to landowners. The esthetic value of nongame wildlife, particularly that of birds, is of paramount importance.

Cody and Tarbox Lakes, each having a surface area of about 50 acres, are the only permanent natural lakes in the county. Maximum depths are between 3 and 5 feet, and the waters are strongly alkaline. No fish are known to live in them. These lakes lie in the poorly drained soils of the Valentine-Els and Gannett-Elsmere soil associations.

Catfish, a few largemouth bass, and northern pike are the game fishes of the South Loup River. Large numbers of nongame species, such as carp, green sunfish, and minnows, are also in the river, as well as in spring-fed marshes that flow into the river. Sites suitable for ponds for the production of fish are limited to those areas of the Valentine-Els and Gannett-Elsmere associations where the water table is at or near the surface most of the year.

Since much of the county is grassland, much of the original potential for wildlife production has been retained. Some areas, particularly marshes and those areas bordering lakes or streams, can be used primarily for wildlife habitat. In most grassland areas, however, wildlife habitat is secondary to the production of hay or grass for cattle.

Areas used primarily for wildlife can be improved by planting woody or herbaceous plants and by protecting them against livestock by fencing or other means. Where trees and shrubs are planted for livestock and farmstead windbreaks, another requirement of some species of wildlife is met. Herbaceous and woody plantings around ponds supply cover for wildlife, and proper stocking and management can produce sustained annual crops of fish.

Table 4 shows the general importance of three kinds of vegetation for important game species. Where the rating is *high* or *medium* the vegetation is considered essential habitat for that particular kind of game species.

Table 5 presents the potential of the soil associations for producing elements of wildlife habitat. For descriptions of the associations and their locations, refer to the section "General Soil Map."

The tendency of people to travel more increases the opportunities of using suitable soils for outdoor recreational

TABLE 4.—*Relative importance of three kinds of vegetation for food and cover for important game species*

[Dashes indicate the habitat element is of no importance]

Wildlife species	Kinds of vegetation and their importance					
	Woody plants for—		Herbaceous plants for—		Grain and seed crops for—	
	Food	Cover	Food	Cover	Food	Cover
Sharp-tailed grouse	High	High	High	High	Medium	Low.
Prairie chicken	High	High	High	High	High	Low.
Deer	High	High	High [1]	Low	High	High.
Antelope	High	Low	High	Low	High	Low.
Pheasant	Low	High	High	High	High	High.
Bobwhite quail	Low	High	High	High	High	High.
Waterfowl					High [2]	
Cottontail	High	High	High	High	High	High.
Fox squirrel	High	High	Low	Low	High	Low.

[1] Medium for white-tailed deer; high for mule deer. [2] For dabbling ducks and geese, principally in spring and fall.

TABLE 5.—*Potential of the soil associations for producing elements of wildlife habitat*

[Dashes indicate that potential for type of wildlife habitat does not occur]

Soil association	Suitability for producing—			
	Woody plants	Herbaceous plants	Grain and seed crops	Aquatic habitat
Valentine	Very poor	Fair	Poor to very poor	
Valentine-Dunday	Fair	Good	Poor	
Valentine-Hersh	Very poor to fair	Good	Poor	
Ovina-Anselmo	Good	Good	Fair to good	
Holdrege-Hord	Good	Good	Good	
Uly-Hersh-Coly	Very poor to fair	Fair to good	Poor to very poor	
Gannett-Elsmere	Poor to very poor	Fair to good	Poor	Very poor to fair.
Valentine-Els	Very poor to fair	Fair to good	Poor	

purposes. In Logan County, these opportunities are primarily oriented towards hunting. However, people who enjoy wildlife appreciate areas where wildlife can be seen or photographed.

Because wildlife is produced on soils used primarily for livestock or crops, the success of a wildlife production program depends on how ranchers use and treat their soils. Almost every practice that helps to protect and improve soils and to conserve water also helps to grow food and cover for wildlife. Improved grass on range and pasture, crop stubble, grassed waterways, terraces, windbreaks, and control of sedimentation aid fish and wildlife directly or indirectly and further the basic measures for conserving soil and water.

Landowners interested in wildlife can develop areas for their own use or for use by sportsmen. Ranchers and landowners can realize an economic return from their wildlife crop, the same as from crops and grasses. Good hunting, fishing, and recreational areas are increasingly in demand and justify lease payments by interested sportsmen. Special-use areas include marsh developments having duck blinds, areas for hunting upland game and big game, water developments for fishing, and cabin and scenic area development. There are small, odd-shaped, or isolated tracts of soils in almost all parts of the county that are ideal for wildlife development. These can be used for the individual landowner's enjoyment.

Developing habitat for wildlife requires proper location and distribution of vegetation. Technical assistance in planning wildlife developments and determining what species of plants to use can be obtained from the Soil Conservation Service. Additional information can be obtained from the Nebraska Game and Parks Commission, the Bureau of Sport Fisheries and Wildlife, and the Federal Extension Service. The Soil Conservation Service provides technical assistance in planning and application of conservation practices for developing outdoor recreation facilities.

Engineering Uses of the Soils [7]

The engineering properties of soil are important because soil provides a very large volume of construction material. Soil provides the foundation for buildings, dams, and highways, as well as providing sand and gravel for road paving and surfacing and for structural concrete. The soil also provides water conveyance and storage locations.

Among the most important engineering properties of soil are particle sizes, permeability, shear strength, compressibility, compaction characteristics, and plasticity. Site conditions, such as depth to the water table, depth to sand and gravel, and topography, are important to engineering use of the soil.

Information in this section of the soil survey can be helpful to those who—

1. Select potential residential, industrial, commercial, and recreational areas.
2. Evaluate alternate routes for roads, highways, pipelines, and underground cables.
3. Seek sources of gravel, sand, or clay.
4. Plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for controlling water and conserving soil.
5. Correlate performance of structures already built with properties of the kinds of soil on which they are built, for the purpose of predicting performance of structures on the same or similar kinds of soil in other locations.
6. Predict the trafficability of soils for cross-country movement of vehicles and construction equipment.
7. Develop preliminary estimates pertinent to construction in a particular area.

Most of the information in this section is presented in tables 6, 7, and 8, which show, respectively, results of engineering laboratory tests on soil samples; estimated soil properties significant in engineering; and interpretations for various engineering uses.

This information, along with the soil map and other parts of the publication, can be used to make interpretations in addition to those given in tables 6, 7, and 8, and it can be used to make other useful maps. Soils of Logan County are deep enough that bedrock does not affect their use.

The information in this section, however, does not eliminate the need for further investigations at sites selected for engineering works, especially works that involve heavy loads or that require excavations to a depth greater than those shown in the tables, generally depths greater than 5 feet.

Terms in this publication are those used by soil scientists and are defined in the Glossary.

Engineering classification systems

Two systems of classifying soils are in general use by engineers. One is the system used by the American Association of State Highway Officials (AASHO) (*1*), and the other is the Unified system, which was developed by the Corps of Engineers, U.S. Department of Defense (*8*).

In the AASHO system, seven groups of soils are classified on the basis of field performance. The groups are classified from A–1 (coarse-grained soils with a high bearing capacity) to A–7 (fine-grained soils with a low bearing capacity when wet). Soils in the A–1, A–2, and A–3 groups are mostly sand and gravel mixtures, whereas those in groups A–4 through A–7 are mostly silt and clay mixtures. The probable performance of the soil on the site is indicated by a group index number.

A sand, silt, and clay soil is further classified by identifying the silt and clay parts. Thus, an A–2–4 soil is an A–2 sand with an A–4 type of silt-clay mixture included.

The group index number ranges from 0 to 20 and is a rating of field performance of the soil. Thus, an A–2–4 (0) soil is one of the best for highway construction. A group index number of 20 indicates one of the least desirable soils for highway location or construction. Group index numbers are given in table 6.

The Nebraska Department of Roads uses a group index of −4 to 32 instead of 0 to 20. This enlarged group index bracket allows plastic and nonplastic, fine-grained soils occurring in sands to be evaluated and the effect of a high clay content (group index greater than 20) to be determined.

Many engineers, including those with the Soil Conservation Service, Bureau of Reclamation, and the Corps of Engineers, use the Unified system. Soils are classified generally as coarse grained, fine grained, and organic or peat.

Fine-grained soils are classified according to plasticity characteristics. Coarse-grained soils are classified primarily according to gradation, and organic soils are classified according to odor and plasticity change after ovendrying.

In the Unified system, combinations of letters are used to identify soil materials and certain properties of the soils: G is used for gravel, S for sand, C for clay, M for silt, W for well graded, P for poorly graded, L for low liquid limit, and H for high liquid limit.

Two letters are combined to classify the soil; for example, SP is sand, poorly graded; CL is a clay of low plasticity; and GC is a gravel and clay mixture. There are 12 possible inorganic classifications and three possible organic classifications. Organic (OL and OH) and peat (Pt) soils are uncommon in Nebraska.

Engineering test data

Table 6 shows engineering test data for several soils in Logan County. These soils represent some of the most extensive soils in the county and cover about 85 percent of the total acreage. Six soil series represented by 15 soil samples were tested for this survey. The tests were made by the Division of Materials and Tests, Nebraska Department of Roads, according to standard procedures of the American Association of State Highway Officials.

[7] By ROBERT J. FREDERICKSON, civil engineer, and MERRITT A. PLANTZ, soil scientist, Soil Conservation Service, and WILLIAM J. RAMSEY, Division of Materials and Tests, Nebraska Department of Roads.

TABLE 6.—*Engineering*

[Tests performed by the Division of Materials and Tests, Nebraska Department of Roads, in accordance

Soil name and location	Parent material	Nebraska Report No.	Depth
			Inches
Anselmo fine sandy loam:			
0.15 mile east and 125 feet north of southwest corner sec. 22, T. 17 N., R. 27 W. (Modal)	Eolian sand and some silts.	S67-3111	0–6
		S67-3112	9–19
		S67-3113	19–60
Els loamy fine sand:			
0.3 mile west and 100 feet north of southeast corner of sec. 36, T. 20 N., R. 27 W. (Surface layer is finer textured than modal)	Wind- and water-deposited fine sand.	S67-3117	0–8
		S67-3118	14–47
Hersh fine sandy loam:			
2,080 feet east and 1,700 feet south of northwest corner of sec. 14, T. 17 N., R. 28 W. (Lowest horizon finer textured than modal)	Eolian sand.	S67-3122	0–4
		S67-3123	10–30
		S67-3124	30–50
Holdrege silt loam:			
35 feet east and 0.4 mile north of southwest corner of sec. 10, T. 17 N., R. 26 W. (Modal)	Peoria loess.	S67-3119	0–6
		S67-3120	17–25
		S67-3121	33–50
Uly silt loam:			
440 feet west and 2,040 feet south of northeast corner of sec. 21, T. 17 N., R. 28 W. (Modal)	Peoria loess.	S67-3125	0–7
		S67-3126	15–60
Valentine fine sand:			
0.2 mile north and 0.1 mile west of center of sec. 36, T. 20 N., R. 28 W. (Modal)	Eolian sand.	S67-3127	5–9
		S67-3128	17–72

[1] Mechanical analyses according to the AASHO Designation T 88–47 (*1*). Results by this procedure frequently may differ somewhat from results that would have been obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS survey procedure, the fine material is analyzed by the pipette method and

test data

with standard procedures of the American Association of State Highway Officials (AASHO)(*1*)]

Mechanical analysis [1]								Liquid limit	Plasticity index	Classification	
Percentage passing sieve—				Percentage smaller than—							
No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 60 (0.25 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.			AASHO [2]	Unified
100	98	91	50	32	14	7	4	19	(3)	A-4(3)	SM or ML
100	97	90	41	26	15	10	8	20	1	A-4(1)	SM
100	97	89	32	21	12	10	9	(3)	(3)	A-2-4(0)	SM
100	99	91	11	9	6	3	3	(3)	(3)	A-2-4(0)	SP-SM
100	99	88	5	4	3	3	3	(3)	(3)	A-3(0)	SP-SM
100	98	90	45	28	11	7	6	19	(3)	A-4(2)	SM
100	97	86	34	21	11	9	7	(3)	(3)	A-2-4(0)	SM
100	99	96	61	36	10	8	7	22	2	A-4(5)	ML
---	---	100	82	44	25	15	12	25	2	A-4(8)	ML
---	---	100	87	68	42	29	24	38	19	A-6(12)	CL
---	---	100	88	64	30	16	9	29	5	A-4(8)	ML
---	---	100	86	58	22	14	8	31	3	A-4(8)	ML
---	---	100	90	54	18	10	8	23	1	A-4(8)	ML
100	99	93	8	5	4	3	3	(3)	(3)	A-3(0)	SP-SM
---	100	95	8	4	3	2	2	(3)	(3)	A-3(0)	SP-SM

the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analyses used in this table are not suitable for use in naming textural classes for soil.

[2] Based on AASHO Designation M 145-49 (*1*).

[3] Nonplastic.

TABLE 7.—*Estimated soil properties*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. These soils appear in the first column. The symbol < means

Soil series and map symbols	Depth to—		Depth from surface	Classification
	Seasonal high water table	Sand		USDA texture
	Feet	*Feet*	*Inches*	
Anselmo: AnB, AnC, AnD, AtA	>10	>5	0–11	Fine sandy loam
			11–29	Fine sandy loam
			29–60	Loamy fine sand and fine sandy loam.
Blown-out land: Bo	>10	0	0–60	Fine sand
*Coly: CoG, CuF	>10	>10	0–9	Light silt loam
For Uly part of CuF, see Uly series.			9–42	Very fine sandy loam
			42–60	Loamy fine sand
*Dunday: DvB, DvD	10	1–5	0–11	Loamy fine sand
For Valentine part, see Valentine series, VbB.			11–60	Fine sand
*Els: Ee	3–6	0	0–7	Fine sand
For Elsmere part, see Elsmere series.			7–60	Fine sand
Elsmere	2–6	0	0–28	Fine sand
Mapped only in an undifferentiated group with Els series.			28–40	Loamy fine sand
			40–60	Stratified; too variable to rate.
Gannett: Ga	0–3	2–3	0–6	Fine sandy loam
			6–23	Loam
			23–60	Fine sand
Hall: Ha	>10	>10	0–22	Silt loam
			22–36	Silty clay loam
			36–42	Silt loam
			42–60	Very fine sandy loam
*Hersh: HeC, HfB, HgD, HgG	>10	>5	0–48	Fine sandy loam
For Anselmo part of HfB, see Anselmo series. For Valentine part of HgD and HgG, see Valentine series, VbB.			48–60	Loamy fine sand
Hobbs: HhA, HhB	>10	>10	0–60	Silt loam
*Holdrege:				
HkC	>10	>10	0–12	Fine sandy loam
			12–28	Heavy silt loam
			28–60	Fine sandy loam
HoC, HoC2, HoD, HoD3, HpB	>10	>10	0–17	Silt loam
For Hord part of HpB, see Hord series.			17–25	Light silty clay loam
			25–60	Silt loam
Hord: HrA, HrB, HrC	>10	>10	0–20	Silt loam
			20–37	Silt loam
			37–60	Loam
Loup: Lo	0–3	1	0–7	Fine sandy loam
			7–14	Loamy fine sand
			14–60	Fine sand

significant to engineering

may have different properties and limitations; therefore it is necessary to follow carefully the instructions for referring to other series that less than; the symbol > means greater than]

Classification—Continued		Percentage of material passing sieve—			Material finer than 0.002 mm.	Permeability	Available water capacity	Reaction	Shrink-swell potential
Unified	AASHO	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)					
					Percent	*Inches per hour*	*Inches per inch of soil*	*pH*	
SM or ML	A-4	100	85-100	36-55	2-15	2. 0-6. 0	0. 16-0. 18	6. 6-7. 3	Very low.
SM or ML	A-4	100	85-100	36-55	2-15	2. 0-6. 0	0. 15-0. 17	7. 4-7. 8	Very low.
SM	A-2 or A-4	100	80-100	20-50	2-10	2. 0-20. 0	0. 08-0. 10	7. 4-7. 8	Very low.
SP or SP-SM	A-3	100	80-95	0-5	0-5	6. 0-20. 0	0. 06-0. 08	6. 1-6. 5	Very low.
ML	A-4	--------	100	70-90	5-15	0. 6-2. 0	0. 22-0. 24	6. 6-8. 4	Low.
ML	A-4	--------	100	60-90	5-15	0. 6-2. 0	0. 17-0. 19	7. 4-8. 4	Low.
SM	A-2	100	85-100	20-35	3-7	6. 0-20. 0	0. 08-0. 10	7. 9-8. 4	Very low.
SM	A-2	100	95-100	20-35	2-10	6. 0-20. 0	0. 10-0. 12	6. 1-6. 5	Very low.
SP-SM or SM	A-2	100	95-100	10-30	2-10	6. 0-20. 0	0. 06-0. 08	6. 6-7. 3	Very low.
SP-SM or SM	A-2 or A-3	100	70-100	5-35	2-10	6. 0-20. 0	0. 07-0. 09	6. 6-7. 8	Very low.
SP-SM or SM	A-2 or A-3	100	70-100	5-30	2-10	6. 0-20. 0	0. 06-0. 08	7. 4-7. 8	Very low.
SP-SM or SM	A-2 or A-3	100	80-100	5-35	2-10	6. 0-20. 0	0. 07-0. 09	7. 4-7. 8	Very low.
SP-SM or SM	A-2 or A-3	100	90-100	5-35	2-10	6. 0-20. 0	0. 06-0. 08	6. 6-7. 3	Very low.
SM or ML	A-4	100	95-100	36-70	5-15	2. 0-6. 0	0. 16-0. 18	7. 4-8. 4	Low.
ML or CL	A-4 or A-6	100	90-100	55-75	7-27	0. 6-2. 0	0. 17-0. 19	7. 4-7. 8	Low.
SP-SM or SM	A-2 or A-3	100	95-100	5-35	2-5	6. 0-20. 0	0. 05-0. 07	7. 4-7. 8	Low.
ML	A-4	--------	100	80-95	10-20	0. 6-2. 0	0. 22-0. 24	6. 1-7. 3	Low.
ML or CL	A-6	--------	100	90-100	20-35	0. 2-0. 6	0. 18-0. 20	6. 6-7. 3	Moderate.
ML or CL	A-4	--------	100	80-95	10-20	0. 6-2. 0	0. 20-0. 22	6. 6-7. 3	Low.
ML	A-4	--------	100	80-90	5-15	0. 6-2. 0	0. 17-0. 19	7. 4-7. 8	Low.
SM or ML	A-2 or A-4	100	90-100	30-65	5-15	2. 0-6. 0	0. 16-0. 18	6. 1-6. 5	Low.
SM	A-2	100	90-100	20-35	2-10	6. 0-20. 0	0. 08-0. 10	6. 6-7. 3	Very low.
ML	A-4	--------	100	80-90	10-20	0. 6-2. 0	0. 20-0. 22	6. 1-7. 8	Low.
SM	A-4	100	90-100	35-50	5-15	2. 0-6. 0	0. 16-0. 18	6. 1-7. 3	Very low.
ML or CL	A-6	100	100	80-90	20-35	0. 6-2. 0	0. 20-0. 22	7. 4-8. 4	Low to moderate.
ML	A-4	100	95-100	60-90	5-20	2. 0-6. 0	0. 14-0. 16	7. 9-8. 4	Low.
ML	A-4	--------	100	80-90	10-20	0. 6-2. 0	0. 22-0. 24	6. 1-7. 3	Low.
CL or ML	A-6	--------	100	85-95	20-35	0. 6-2. 0	0. 18-0. 20	7. 4-8. 4	Moderate.
ML	A-4	--------	100	80-95	5-20	0. 6-2. 0	0. 20-0. 22	7. 9-8. 4	Low.
ML	A-4	--------	100	80-95	10-20	0. 6-2. 0	0. 22-0. 24	6. 1-7. 3	Low.
ML or CL	A-4 or A-6	--------	100	80-100	20-30	0. 6-2. 0	0. 20-0. 22	6. 6-7. 8	Low to moderate.
ML	A-4	--------	100	80-95	15-25	0. 6-2. 0	0. 17-0. 19	7. 4-7. 8	Low.
SM	A-2 or A-4	100	95-100	20-45	2-20	2. 0-6. 0	0. 16-0. 18	6. 1-8. 4	Very low.
SM	A-2	100	90-100	12-30	2-10	6. 0-20. 0	0. 09-0. 11	7. 4-7. 8	Very low.
SP-SM or SM	A-2 or A-3	100	85-100	5-25	0-5	6. 0-20. 0	0. 05-0. 07	6. 1-7. 3	Very low.

TABLE 7.—*Estimated soil properties*

Soil series and map symbols	Depth to—		Depth from surface	USDA texture
	Seasonal high water table	Sand		
	Feet	*Feet*	*Inches*	
Marsh: Ma. Properties too variable for reliable estimates to be made. Onsite determinations necessary.				
Ord: Or, Os	2. 5–5	2	0–10	Fine sandy loam
			10–23	Fine sandy loam
			23–60	Fine sand
Ovina: Ov	5–8	>5	0–5	Fine sandy loam
			5–9	Very fine sandy loam
			9–60	Fine sandy loam
Rough broken land, loess: Rb	>10	>10	0–60	Silt loam
Scott: Sc	>10	>10	0–8	Silt loam
			8–40	Silty clay
			40–60	Loam
Tryon: Tn	1–3	1–4	0–5	Loamy fine sand
			5–60	Fine sand
*Uly: UaA, UcG, UhD, UhF. For Coly part of UcG, see Coly series. For Holdrege part of UhD and UhF, see Holdrege series, HoC.	>10	>10	0–9	Silt loam
			9–23	Silt loam
			23–60	Very fine sandy loam
Valentine: VaB, VaF, VaG, VcG	>10	0	0–60	Fine sand
VbB, VbE	>10	2–3	0–27	Loamy fine sand
			27–60	Fine sand
Vetal: Vt	>5	>5	0–60	Fine sandy loam
Wet alluvial land: Wa. Properties too variable for reliable estimates to be made. Onsite determinations necessary.				

significant to engineering—Continued

Classification		Percentage of material passing sieve—			Material finer than 0.002 mm.	Permeability	Available water capacity	Reaction	Shrink-swell potential
Unified	AASHO	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)					
					Percent	*Inches per hour*	*Inches per inch of soil*	*pH*	
SM	A-2 or A-4	100	90–100	20–50	2–20	2. 0–6. 0	0. 16–0. 18	6. 6–9. 0	Very low.
SM	A-2	100	90–100	15–35	2–20	2. 0–6. 0	0. 15–0. 17	7. 9–8. 4	Very low.
SM or SP-SM	A-2 or A-3	100	85–100	5–25	2–10	6. 0–20. 0	0. 05–0. 07	7. 4–7. 8	Very low.
SM	A-2 or A-4	100	90–100	30–50	2–15	2. 0–6. 0	0. 16–0. 18	6. 1–7. 8	Low.
SM or ML	A-4	100	90–100	45–65	5–20	0. 6–2. 0	0. 17–0. 19	6. 6–7. 8	Low.
SM	A-2 or A-4	100	90–100	30–50	5–15	2. 0–6. 0	0. 14–0. 16	7. 9–8. 4	Low.
ML	A-4	----------	100	80–95	5–15	0. 6–2. 0	0. 20–0. 22	7. 4–8. 4	Low.
ML or CL	A-4 or A-6	----------	100	90–100	10–25	0. 6–2. 0	0. 22–0. 24	6. 1–6. 5	Low to moderate.
CL or CH	A-7	----------	100	95–100	40–50	<0. 06	0. 11–0. 13	6. 1–7. 3	High.
ML or CL	A-4 or A-6	----------	90–100	51–95	10–30	0. 6–2. 0	0. 17–0. 19	6. 6–7. 3	Low.
SM	A-2	100	90–100	20–35	2–15	6. 0–20. 0	0. 10–0. 12	6. 6–8. 4	Very low.
SM or SP-SM	A-2 or A-3	100	95–100	5–20	2–10	6. 0–20. 0	0. 06–0. 08	7. 4–7. 8	Very low.
ML	A-4	----------	100	80–90	5–15	0. 6–2. 0	0. 22–0. 24	6. 6–7. 8	Low.
ML or CL	A-4 or A-6	----------	100	85–95	10–20	0. 6–2. 0	0. 20–0. 22	7. 4–8. 4	Low to moderate.
ML	A-4	----------	100	80–95	5–15	0. 6–2. 0	0. 17–0. 19	7. 9–8. 4	Low.
SP-SM or SM	A-2 or A-3	100	95–100	5–20	2–8	6. 0–20. 0	0. 07–0. 09	6. 1–7. 3	Very low.
SM or SP-SM	A-2	100	95–100	10–20	2–10	6. 0–20. 0	0. 10–0. 12	6. 1–7. 3	Low.
SP or SP-SM	A-2 or A-3	100	95–100	3–20	2–8	6. 0–20. 0	0. 05–0. 07	6. 6–7. 3	Very low.
SM or ML	A-4	100	95–100	35–55	2–20	2. 0–6. 0	0. 15–0. 17	6. 6–7. 8	Low.

TABLE 8.—*Engineering*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two kinds of soil. The soils in such
referring to other series that appear

Soil series and map symbols	Suitability as source of—					Soil features affecting—	
	Road fill	Sand	Topsoil	Road subgrade		Highway location	Foundations
				Paved surface	Gravel surface		
Anselmo: AnB, AnC, AnD, AtA.	Good to fair.	Poor to fair.	Fair: erodible.	Good to fair.	Fair	Susceptible to frost heaving if surface soil is used for subgrade; erodible slopes; fair stability.	Very slight compressibility; water table at a great depth; moderately rapid permeability.
Blown-out land: Bo	Good	Good	Poor: coarse texture.	Good	Poor	Subject to soil blowing; rough topography; erodible slopes.	Very slight compressibility; rapid permeability.
*Coly: CoG, CuF. For Uly part of CuF, see Uly series.	Fair to poor.	Unsuited: not available.	Poor: thin surface layer.	Fair to poor.	Good to fair.	Subject to high consolidation when loaded and wetted; rough topography; water table at a great depth; erodible slopes.	Moderate permeability; subject to consolidation; water table at a great depth.
*Dunday: DvB, DvD. For Valentine part of these units, see Valentine series, VbB.	Good	Poor to fair.	Poor to fair: coarse texture.	Good	Fair to poor.	Very low shrink-swell potential; low susceptibility to frost heaving; water table at a great depth; high permeability.	Good bearing capacity when confined; water table at a great depth; rapid permeability.
*Els: Ee. For Elsmere part, see Elsmere series.	Good	Fair	Poor: coarse texture.	Good	Fair to poor.	Requires fill; high water table; erodible fill slopes.	Good bearing capacity; high water table.

See footnote at end of table.

interpretations

mapping units may have different properties and limitations, and for this reason, it is necessary to follow carefully the instructions for in the first column of this table]

Soil features affecting—Continued						Degree and kind of limitation for—	
Pond reservoir area	Embankments, dikes, and levees	Drainage of cropland and pasture	Irrigation	Terraces and diversions	Grassed waterways	Filter fields	Sewage lagoons
Moderately rapid permeability; needs sealing to store water.	Needs compaction control.	Well drained--	Hazard of erosion and soil blowing; moderate slopes in places; moderately rapid permeability; moderate available water capacity.	Uneven slopes in places; danger of soil blowing; slow to medium runoff.	Subject to erosion and soil blowing; dry soils.	Slight, except moderate where slopes are moderate.	Severe: moderately rapid permeability; moderate slopes in places; needs sealing to function.
Rapid permeability.	Rapid permeability; subject to soil blowing and erosion.	Excessively drained.	Generally not needed.	Generally not needed.	Difficult to vegetate; low fertility; low available water capacity; subject to soil blowing.	Slight [1]-------	Severe: rapid permeability; needs lining to function.
Moderate permeability; needs lining to retain water; moderate to steep slopes.	Needs compaction control; subject to erosion.	Well drained--	Generally not needed.	Moderate to steep slopes; rapid runoff.	Moderate to steep slopes; subject to erosion; low fertility.	Severe: moderate to steep slopes.	Severe: moderate to steep slopes; needs lining to function.
Rapid permeability; needs lining to store water.	Fair stability; fair to good compaction; high permeability.	Somewhat excessively drained.	Subject to soil blowing; low available water capacity.	Subject to soil blowing; slow to very slow runoff.	Subject to soil blowing.	Slight [1]-------	Severe: rapid permeability; needs sealing or lining to function.
Water table at depth of 3 to 6 feet; suitable for dugouts.	Subject to soil blowing; high water table; horizontal seepage possible.	Somewhat poorly drained; poor outlets for drains.	Coarse texture; hazard of soil blowing; somewhat poorly drained; low available water capacity; subirrigated.	Generally not needed.	Generally not needed.	Severe: water table at depth of 3 to 6 feet; hazard of contaminated ground water.	Severe: water table at depth of 3 to 6 feet; rapid permeability; needs sealing or lining to function.

TABLE 8.—*Engineering*

Soil series and map symbols	Suitability as source of—					Soil features affecting—	
	Road fill	Sand	Topsoil	Road subgrade		Highway location	Foundations
				Paved surface	Gravel surface		
Elsmere---------- Mapped only with Els series.	Good------	Fair to poor: contains stratified fines.	Fair to poor.	Good------	Fair to poor.	Subject to frost heaving; requires fill; high water table; erodible fill slopes.	Fair bearing capacity; high water table.
Gannett: Ga---------	Suitability depends on depth of soil and amount of water.	Good below depth of 2 feet.	Fair to poor.	Poor to fair for surface borrow; good below depth of 2 feet.	Poor-------	High water table; susceptible to frost heaving; requires fill; erodible fill slopes.	High water table; good bearing capacity below depth of 2 feet.
Hall: Ha----------	Fair: compaction control needed.	Poor-------	Good------	Fair to poor.	Good------	Nearly level; well drained; moderate frost heaving; moderate shrink-swell potential.	Nearly level; moderate shrink-swell potential; susceptible to frost heaving; subject to consolidation.
*Hersh: HeC, HfB, HgD, HgG. For Anselmo part of HfB, see Anselmo series; for Valentine part of HgD and HgG, see Valentine series, VbB.	Good to fair: erodible slopes.	Poor to fair: high quality sand generally not available.	Fair to poor: thin surface layer.	Good to fair.	Good to fair.	Susceptible to frost heaving; erodible slopes; water table at a great depth.	Consolidation depends on density; moderately rapid permeability; water table at a great depth.
Hobbs: HhA, HhB----	Fair--------	Unsuited: not available.	Good-------	Fair to poor.	Good to fair.	Slight flooding hazard; nearly level; susceptible to frost heaving; subject to high consolidation when wetted and loaded; water table at a great depth.	Nearly level; subject to consolidation; moderate permeability; water table at a great depth.

See footnote at end of table.

interpretations—Continued

Soil features affecting—Continued						Degree and kind of limitation for—	
Pond reservoir area	Embankments, dikes, and levees	Drainage of cropland and pasture	Irrigation	Terraces and diversions	Grassed waterways	Filter fields	Sewage lagoons
Water table at depth of 2 to 6 feet; suitable for dugouts.	High water table; subject to horizontal seepage.	Somewhat poorly drained; poor outlets for drains.	Coarse texture; somewhat poorly drained.	Generally not needed.	Generally not needed.	Severe: water table at depth of 2 to 6 feet; hazard of contaminated ground water.	Severe: water table at depth of 2 to 6 feet; needs sealing or lining to function.
Water table at depth of 0 to 3 feet; suitable for dugouts.	High water table; subject to horizontal seepage.	Poorly drained; wet areas lower than outlets.	Generally not needed.	Generally not needed.	Generally not needed.	Severe: water table at depth of 0 to 3 feet; hazard of contaminated ground water.	Severe: high water table.
Moderately permeable in lower part of profile; needs sealing; suitable for dugouts.	Compaction control needed; impervious; erodible slopes.	Well drained--	Well drained; moderately slow permeability; high available water capacity; nearly level; moderate to slow intake rate.	Nearly level; slow runoff.	Easily vegetated.	Moderate: moderately slow permeability; well drained.	Slight to moderate: moderate permeability in lower part of profile; needs sealing or lining to function.
Moderately rapid permeability limits storage.	Fair to good compaction; impervious.	Well drained--	Subject to erosion and soil blowing; steep and uneven slopes in places; moderately rapid permeability; moderate available water capacity.	Uneven and steep slopes in places; danger of soil blowing.	Subject to erosion and soil blowing.	Slight to severe: slopes are too steep in places.	Severe: moderately rapid permeability; steep slopes in places; needs sealing or lining to function.
Moderate permeability; too high for storing water without sealing.	Needs compaction control; impervious; erodible slopes.	Well drained to moderately well drained; subject to flooding; terraces needed on land above.	Well drained; high available water capacity; nearly level to very gentle slopes.	Subject to erosion and soil blowing; slow to medium runoff.	Subject to erosion and soil blowing.	Slight: moderate permeability.	Moderate: needs sealing or lining to function.

TABLE 8.—*Engineering*

Soil series and map symbols	Suitability as source of—					Soil features affecting	
	Road fill	Sand	Topsoil	Road subgrade		Highway location	Foundations
				Paved surface	Gravel surface		
*Holdrege: HkC	Fair	Unsuited: not available.	Fair	Fair to poor.	Good	Gentle slopes; susceptible to frost heaving; low to moderate shrink-swell potential; high consolidation when wetted and loaded.	Gentle slopes; low to moderate shrink-swell potential; water table at a great depth; high consolidation when wetted and loaded.
HoC, HoC2, HoD, HoD3, HpB. For Hord part of HpB, see Hord series.	Fair	Unsuited: not available.	Good	Fair to poor.	Good	Cuts and fill needed because of topography; subject to consolidation when wetted and loaded; water table at a great depth; compaction control needed; subject to soil blowing and erosion.	Low to moderate shrink-swell potential; subject to consolidation; water table at a great depth.
Hord: HrA, HrB, HrC.	Fair	Unsuited: not available.	Good	Fair to poor.	Good	Nearly level and gentle slopes; low to moderate shrink-swell potential; water table at a great depth; erodible slopes.	Low to moderate shrink-swell potential; subject to settlement; water table at a great depth.
Loup: Lo	Poor: high water table.	Good for fine sand below depth of 1 foot.	Poor: high water table; coarse texture.	Fair: high water table.	Poor	Low shrink-swell potential; susceptible to frost heaving; requires fill above high water table.	High water table.
Marsh: Ma. Properties too variable for reliable estimates. Onsite determinations necessary.							

See footnote at end of table.

interpretations—Continued

Soil features affecting—Continued						Degree and kind of limitation for—	
Pond reservoir area	Embankments, dikes, and levees	Drainage of cropland and pasture	Irrigation	Terraces and diversions	Grassed waterways	Filter fields	Sewage lagoons
Moderate permeability and seepage rate; needs sealing to store water.	Fair compaction characteristics; moderate permeability when compacted.	Well drained	Well drained; uneven slopes in places; high available water capacity.	Uneven slopes in places; subject to soil blowing.	Subject to soil blowing; well drained.	Slight for trenches more than 2 feet deep.	Severe: needs sealing or lining to function.
Moderate permeability; slope; needs sealing to store water.	Fair compaction characteristics; erodible slopes; water table at a great depth; impervious.	Well drained	Well drained; high available water capacity; moderate slopes in places; moderate to slow intake rate.	Moderate permeability; slope; subject to soil blowing and erosion.	High available water capacity; moderate slopes in places.	Moderate where slopes are 3 to 11 percent; moderate permeability.	Moderate where slopes are less than 5 percent; severe where slopes are greater than 5 percent; moderate permeability.
Moderate permeability; needs sealing to store water; nearly level to gentle slopes.	Fair compaction characteristics; impervious; water table at a great depth.	Well drained	Well drained; high available water capacity; subject to erosion and soil blowing.	Moderate permeability; subject to erosion and soil blowing.	High available water capacity; erodible.	Slight: moderate permeability; moderate for slopes greater than 5 percent.	Moderate where slopes are less than 5 percent; severe where slope are greater than 5 percent; moderate permeability.
High water table; suitable for dugouts.	Fair compaction; high permeability; subject to horizontal seepage.	Poorly drained; suitable outlets difficult to find.	Generally not needed.	Generally not needed.	Generally not needed.	Severe: high water table; hazard of contaminated ground water.	Severe: high water table; rapid permeability.

TABLE 8.—*Engineering*

Soil series and map symbols	Suitability as source of—					Soil features affecting—	
	Road fill	Sand	Topsoil	Road subgrade		Highway location	Foundations
				Paved surface	Gravel surface		
Ord: Or, Os	Good below depth of 2 feet.	Fair below depth of 2 feet for fine sand.	Poor	Fair; good below depth of 2 feet.	Fair to poor.	Water table at depth of 2½ to 5 feet; nearly level to very gentle slopes; susceptible to frost heaving; requires minimum fill above water table.	Nearly level to very gentle slopes; high water table.
Ovina: Ov	Good	Fair to poor.	Fair	Fair to good.	Fair to poor.	Nearly level to very gentle slopes; susceptible to frost heaving; high water table in places; erodible slopes.	Nearly level to very gentle slopes; moderately rapid permeability; excavations below depth of 5 feet may encounter water.
Rough broken land, loess: Rb.	Fair: very steep slopes.	Unsuited: not available.	Poor: very steep slopes.	Poor	Good	Very steep slopes; erodible slopes; water table at a great depth; subject to consolidation when wetted and loaded.	Very steep slopes; fair to poor soil compaction.
Scott: Sc	Poor: frequently flooded; high shrink-swell potential.	Unsuited: not available.	Poor: poorly drained.	Poor	Good	Frequently flooded; high shrink-swell potential; susceptible to frost heaving; requires fill above flooding; needs compaction control.	Frequently flooded; high shrink-swell potential.
Tryon: Tn	Fair to good.	Poor	Poor: subject to flooding; poorly drained.	Fair	Poor	High water table; susceptible to frost heaving, nearly level; requires minimum fill; erodible slopes.	Nearly level; high water table.

See footnotes at end of table.

interpretations—Continued

Soil features affecting—Continued						Degree and kind of limitation for—	
Pond reservoir area	Embankments, dikes, and levees	Drainage of cropland and pasture	Irrigation	Terraces and diversions	Grassed waterways	Filter fields	Sewage lagoons
Nearly level; water table at depth of 2½ to 5 feet; suitable for dugouts.	Fair stability; moderate permeability when compacted; subject to horizontal seepage.	Somewhat poorly drained; suitable outlets generally not available.	Somewhat poorly drained; alkali in places; moderate available water capacity; nearly level to very gentle slopes.	Slow runoff; may need water tolerant grasses.	Somewhat poorly drained; may need water tolerant grasses.	Severe: water table at depth of 2½ to 5 feet; moderately rapid permeability; possible contamination of ground water.	Severe: water table at depth of 2½ to 5 feet; moderately rapid permeability; needs lining to function properly and to avoid contamination of ground water.
Moderately rapid permeability; suitable for dugouts over 5 feet deep.	Fair compaction; moderate permeability when compacted; subject to horizontal seepage; erodible slopes.	Moderately well drained.	Nearly level to very gentle slopes; moderate available water capacity.	Slow to medium runoff; subject to soil blowing and erosion.	Moderate available water capacity; subject to soil blowing and erosion.	Slight to moderate: moderately rapid permeability; water table at depth of 5 to 8 feet; ground water may be contaminated.	Severe: moderately rapid permeability; needs sealing or lining to function.
Very steep slopes; moderate permeability.	Needs compaction control; impervious when compacted; rough topography.	Very rapid----	Generally not needed.	Very steep slopes; very rapid runoff; subject to soil blowing and erosion.	Very steep slopes; subject to soil blowing and erosion.	Severe: very steep slopes.	Severe: very steep slopes; high vertical permeability.
Very slow permeability; nearly level.	Very slow permeability; high shrink-swell potential; needs close compaction control.	Poor surface drainage; very slow permeability; no available outlets.	Generally not needed.	Terraces generally not needed erodible diversion slopes.	Generally not needed.	Severe: very slow permeability; frequently flooded.	Severe: frequently flooded; needs diking for protection.
Seasonal high water table; suitable for dugouts.	Rapid permeability; subject to horizontal seepage; needs compaction control.	Poorly drained; suitable outlets generally not available.	Generally not needed.	Generally not needed.	Generally not needed.	Severe: high water table; possible contamination of ground water.	Severe: high water table; rapid permeability.

TABLE 8.—*Engineering*

Soil series and map symbols	Suitability as source of—					Soil features affecting—	
	Road fill	Sand	Topsoil	Road subgrade		Highway location	Foundation
				Paved surface	Gravel surface		
*Uly: UaA, UcG, UhD, UhF. For the Holdrege part of UhD and UhF, see the Holdrege series, HoC.	Fair	Unsuited: not available.	Fair to poor.	Fair to poor.	Good to fair.	Good drainage; strong slopes in places; erodible slopes; requires close compaction control; subject to consolidation when wetted and loaded.	Nearly level to strongly sloping; well drained; subject to consolidation.
Valentine: VaB, VaF, VaG, VcG.	Good	Good to fair.	Poor: coarse texture.	Good to fair.	Fair to poor.	Subject to soil blowing and erosion; steep slopes in places; low susceptibility to frost heaving; water table at a great depth.	Fair to good bearing capacity; good shear strength; sand must be confined; water table at a great depth.
VbB, VbE	Good	Good to fair.	Poor: coarse texture.	Good to fair.	Fair to poor.	Subject to soil blowing and erosion; low susceptibility to frost heaving; water table at a great depth.	Fair to good bearing capacity; good shear strength; sand must be confined; water table at a great depth.
Vetal: Vt	Good to fair.	Poor	Good	Fair to poor.	Good to fair.	Nearly level; well drained; moderate susceptibility to frost heaving; requires compaction control; subject to soil blowing and erosion.	Good to fair bearing capacity; nearly level; check for allowable settlements of structures.
Wet alluvial land: Wa. Properties too variable for reliable estimates. Onsite determinations necessary.							

[1] Pollution may be a hazard in places because of permeability in substratum.

interpretations—Continued

Soil features affecting—Continued						Degree and kind of limitation for—	
Pond reservoir area	Embankments, dikes, and levees	Drainage of cropland and pasture	Irrigation	Terraces and diversions	Grassed waterways	Filter fields	Sewage lagoons
Moderate permeability; strong slopes in places; needs sealing to store water.	Medium compressibility; requires compaction control; impervious when compacted; erodible slopes.	Well drained	Well drained; nearly level to strongly sloping; not suited where slopes are greater than 9 percent.	Moderate permeability; nearly level to strongly sloping; erodible slopes.	High available moisture capacity; erodible slopes.	Slight where slopes are 0 to 5 percent; severe where slopes are greater than 5 percent.	Moderate where slopes are less than 5 percent; severe where slopes are greater than 5 percent.
Rapid permeability; water storage generally not feasible.	Rapid permeability; subject to soil blowing and erosion; water storage generally not feasible.	Excessively drained.	Low available water capacity; sandy texture; rolling to hilly.	Slow to very slow runoff.	Low available water capacity; maintenance difficult.	Slight for mapping unit VaB, moderate for VaF, and severe for VaG and VcG.	Severe: rapid permeability; slope; needs sealing or lining to function.
Rapid permeability.	Rapid permeability; subject to soil blowing and erosion; water storage generally not feasible.	Somewhat excessively drained to excessively drained.	Low available water capacity; sandy texture.	Very slow runoff.	Low available water capacity; maintenance difficult.	Slight for mapping unit VbB and moderate for VbE.	Severe: rapid permeability; needs sealing or lining to function.
Nearly level; moderately rapid permeability; needs sealing to store water; suitable for dugouts.	Fair compaction; low permeability when compacted; subject to horizontal seepage.	Well drained	Nearly level; medium available water capacity; well drained.	Slow runoff; moderately rapid permeability.	Medium available water capacity.	Slight	Severe: moderately rapid permeability; needs sealing or lining to function.

Each soil listed in table 6 was sampled at only one location, and the data given for the soil are those at that location. From one location to another, a soil can differ considerably in characteristics that affect engineering. Even where soils are sampled at more than one location, the test data probably do not show the widest range in characteristics.

The engineering classifications in the last two columns of table 6 are based on data obtained by mechanical analysis and on tests to determine the liquid limit and plastic limit of the soil. The mechanical analysis was made by a combination of the sieve and hydrometer methods.

Tests for liquid limit and plasticity index measure the effect of water on the consistency of the soil material. As the moisture content of a clay soil is increased from a dry condition, the soil changes from a semisolid to a plastic state and then to a liquid state. The plastic limit is that moisture content, expressed as a percentage of the ovendry weight of the soil, at which the soil passes from a semisolid to a plastic state. The liquid limit is that moisture content at which the soil passes from a plastic to a liquid state. The plasticity index is the numerical difference, in percent of moisture, between the liquid limit and the plastic limit. It indicates a range of moisture content within which soil is considered to be plastic. Some silty and sandy soils are nonplastic, which means they will not become plastic at any moisture content.

Soil properties significant to engineering

In table 7 soil properties significant to engineering are estimated. For detailed information about the soils refer to the section "Descriptions of the Soils," and for information about geology, to the section "How the Soils of Logan County Were Formed and How They Are Classified."

The estimates in table 7 were based on the engineering test data in table 6 and on other information obtained in the county during the survey. The data are listed by layers that have properties significant to engineering. These data include the textural classification of the United States Department of Agriculture and the AASHO and Unified engineering classifications. Also listed for each layer are the percentages of material that will pass a No. 10 sieve, a No. 40 sieve, and, a No. 200 sieve, and the percentage finer than 0.002 millimeter as determined by the hydrometer method. Estimates of the percentage passing the sieves are based on the assumption that material up to and including 3 inches in diameter equals 100 percent. There are no soils in Logan County that have particles that do not pass the No. 10 sieve (larger than 2.0 millimeters).

In the AASHO and Unified systems, soil particles retained on the No. 200 sieve are classed as sand and gravel. Silt and clay particles will pass through this sieve. In the AASHO system particles retained on the No. 10 sieve are classed as gravel, and in the Unified system particles retained on the No. 4 sieve are classed as gravel. The range of values shown in table 7 for the percentage of soil finer than 0.002 millimeter represents the estimated clay fraction of the soil. Silt and clay particles affect such properties as strength, permeability, compaction, and shrink-swell potential.

In tables 6 and 7 the percentage of clay is based on an analysis that uses the hydrometer method. This can give results that differ slightly from those obtained with the pipette method used by SCS soil scientists to obtain results by standard soil survey procedures.

In table 7, permeability refers to the rate at which water moves through a saturated soil. It depends largely on gradation, structure, and density. The rate is given in inches of water per hour. Rates are given for the major soil horizons. Terms used to describe permeability and the equivalent rates are given in the Glossary.

Available water capacity is the capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. In the table it is expressed as inches of water per inch of soil.

Soil dispersion is not a serious problem in the county, because few areas contain enough salts to produce moderate dispersion. Salinity is generally not a problem. However, some areas in the somewhat poorly drained soils on bottom lands along the South Loup River are affected by alkali. Ord fine sandy loam, alkali, is an example. Onsite investigations need to be made in all areas where alkali poses a hazard to construction work.

A generalized rating for shrink-swell potential is given in table 7. A few soils, such as those in the Hall and Scott series, have moderate to high shrink-swell potential. Generally, soils with a high content of expandable clay, such as montmorillonite, undergo a volume change when the soil moisture is changed. Clean sands and gravel undergo little or no volume change when wetting or drying occurs.

Reaction of a soil is the degree of acidity or alkalinity, expressed as a pH value or reaction class. A soil with a value of 7.0 is neutral; one with a lower value is acid; and a soil with a pH greater than 7.0 is alkaline. In Logan County, soil materials with approximate pH values greater than 7.8 and less than 6.3 need to be investigated for the potential corrosion they may cause to metal structures. The reaction class for most horizons of the representative profile is given in table 7. Soils used as construction materials need to be tested for corrosion potential when moist or wet.

Engineering interpretations

Table 8 gives general interpretations of the soils for their use in engineering. This table can be used as a guide to planning and further investigations of the soils. It cannot replace onsite investigation of specific tracts of land.

Ratings for suitability of soil as road fill include suitability as embankment or as a foundation for embankments, erodibility of cut and fill slopes, and potential frost action.

Several soils in Logan County are a source of fine sand. There are no known sources of coarse sand or of gravel.

Topsoil is rated *good*, *fair*, or *poor*, depending on depth, fertility, organic matter, erosiveness, workability, and quantity. Topsoil is used to cover road and dam embankments, excavated slopes, and gardens and lawns.

Sands and gravel are rated *good* to *fair* for subgrades under pavement and *poor* for gravel road subgrades. Silt and clay on the road subgrade surface is more stable than sand or gravel for gravel-surfaced roads. Thus, for

paved roads, soils classified A–1 and A–3 are rated *good;* A–2, *good* to *fair;* A–4, *fair* to *poor;* and A–6 or A–7, *poor.* For most soils the road subgrade (foundation) and road fill use the same classification for paved roads because the engineering requirements are approximately the same.

Among the soil properties that affect highway locations are potential hazard of frost heaving, shrink-swell potential, erodibility of cut and fill slopes, possible flooding, and depth to water table. Frost action is caused by the expansion of freezing water in silts and clays, and this, in turn, increases maintenance of paved roads. A high water table can contribute to potential frost action or frost heaving.

An important soil property that affects foundations is bearing, or load-carrying, capacity. Most soils have a high bearing capacity when dry. Some of the windblown soils are subject to high consolidation when saturated under load. Sands and gravels have high bearing capacity when confined. Specific values for bearing capacity (for example, pounds per square inch) should not be assigned to estimated values as expressed in words in table 8. Excavating for buildings when the soil is wet may cause a problem. Therefore, depth to water should be determined at the building site. The shrink-swell potential given in table 7 is important in determining the sites for foundations. The possibility of seepage into foundations or excavations is indicated in table 8.

Embankments are subject to seepage and compressibility. These factors are rated in table 8. Workability includes hauling and compaction characteristics. Potential seepage depends on moisture, gradation, and compaction of the fill. Erodibility of fill slopes is also described. Two methods of compaction are required for soils in Logan County. Soils containing approximately 15 percent or less of silt and clay particles should have compaction controlled by the relative density test. This test is equivalent to the use of vibratory rollers rather than sheepsfoot rollers. Soils containing approximately 15 percent or more of silt and clay particles are generally compacted with sheepsfoot, or tampering rollers, with moisture controlled at or above a minimum limit.

Dikes and levees are used to control surface water. They are subject to soil blowing and erosion and are subject to horizontal seepage if they are not properly compacted or if they are constructed of clean sands. Some soils are subject to shrinkage and cracking upon drying. Dikes and levees constructed with sandy soils need gentle slopes for stability. Steeper slopes are used for dikes and levees constructed with clay soil because the fill is relatively impervious to water.

For pond reservoir areas, potential seepage of the soil and the use of the soil for embankments are described in table 8. A high water table indicates the possibility of excavating a dugout for a water supply. A low water table, or one at a great depth, may indicate the need for sealing or lining a pond; it also indicates that construction of a fill may be easier because there is a drier base for foundations.

Drainage for cropland and pasture, as listed in table 8, depends on the depth to the water table, available outlets, and the permeability of the various soil layers.

Suitability of soils for irrigation is affected by such properties as available water capacity, permeability, water intake rate, steepness of slopes, and possible limiting depths of leveling cuts. The ratings for available water capacity are limited to the upper 5 feet of soil. The capacity is *high* if the soil holds more than 9 inches of water, *moderate* if the soil holds 6 to 9 inches, *low* if the soil holds 3 to 6 inches, and *very low* if the soil holds less than 3 inches. Further information on the use of soils for irrigated crops is contained in "The Irrigation Guide for Nebraska," 1971, Soil Conservation Service.

Intake rate is the rate of movement of water into the soil. The intake rate is affected by the permeability of the various soil layers being irrigated. Intake ratings are given for some soils in table 8, and a permeability range is given in table 7. The intake rate is *rapid* if the soil takes in more than 2 inches of water per hour; *moderate* if the rate is from 0.5 inch to 2 inches per hour; and *slow* if less than 0.5 inch per hour. Soils not rated for intake rate are either moderate or rapid or generally are not irrigated.

Use of the soils for terraces and diversions and for grassed waterways is affected by the possible loss of soil material through soil blowing and erosion, difficulty of establishing vegetation, and soil fertility. Maintenance costs of terraces and diversions are greater where siltation occurs from areas at higher elevations. Depth to erodible sands limits the depth of cuts for diversion alinement. Rough terrain and steep slopes are factors in terrace and diversion alinement.

For sewage disposal, the limitations to use of the soils for sewage filter fields and sewage lagoons are given in table 8. Use of soils for sewage disposal can also be related to information given in table 7, which includes the engineering classifications, values for permeability, and available water capacity. For filter fields, soil limitations are *slight, moderate,* or *severe. Slight* indicates good infiltration without contaminating the underground water; *moderate* indicates a finer grained soil that has a lower intake rate; and *severe* indicates a soil that has a high water table or is impervious.

For sewage lagoons, water must be retained in the lagoon for aerobic decomposition of the fresh sewage to occur. Thus, an impervious soil is desired for constructing this facility. The probability of a soil requiring sealing with bentonite or sodium carbonate or lining with a commercial plastic or rubber liner is indicated. A soil may have potential of being reworked and compacted to provide a liner. A lagoon constructed in sandy material with a high water table would be the least desirable sewage disposal facility. A sewage filter field or disposal lagoon needs to be located so as not to contaminate wells that furnish domestic water supply or water for stock. Other factors, such as steepness of slope and possibility of flooding, need to be considered in sewage treatment design.

How the Soils of Logan County Were Formed, and How They Are Classified

This section consists of two main parts. The first part tells how the factors of soil formation have affected the development of soils in Logan County. The second ex-

plains the system of soil classification currently used and places each soil series in some of the categories of that system.

Factors of Soil Formation

Soil is produced by soil-forming processes acting on materials deposited or accumulated by geologic agencies. The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material, (2) the climate under which the soil material has accumulated and existed since accumulation, (3) the plant and animal life on and in the soil, (4) the relief, or lay of the land, and (5) the length of time the forces of soil formation have acted on the soil material.

Climate and plant and animal life, chiefly plants, are active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it to a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material also affects the kind of soil profile that is formed and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent material into a soil profile. It may be much or little, but some time is always required for differentiation of soil horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four. Many of the processes of soil development are unknown.

Parent material

The soils of Logan County formed in four kinds of parent material. These are windblown (eolian) sand, windblown silt (mostly Peoria loess), alluvium, and colluvium. All four materials appear to have been deposited in recent geologic time (*2*).

Most soils north of the South Loup River, and some soils south of it, formed in windblown sand. Valentine soils, which formed in this coarse, noncalcareous material, are by far the most widespread and make up much of the grassland in the county.

These sand deposits range from a few inches to many feet in thickness. More than 50 percent of this sand is in the size range of 0.25 to 0.1 millimeter, which the U.S. Department of Agriculture classes as fine sand. It seldom contains as much as 10 percent coarse sand or 10 percent particles as fine as silt. The mineralogy of the sand is mostly quartzitic. Weathering of this sand is very slow, and coarse-textured soils result.

Loess, a silty wind-deposited material, forms a mantle over much of the area south of the South Loup River. It is believed to have been separated by the wind from sand to the north and west. Most of the loess is light gray to very pale brown. It ranges from a few inches to several feet in thickness but has been eroded away along drainageways and covered or mixed with windblown sand.

Many of the tillable soils in the county, such as the Holdrege, and some of the grassland soils, such as the Uly, formed in loess. These soils are older and show more soil development than most of the sandy soils in the county.

Water-deposited materials are called alluvium. Alluvium consists of silt, clay, sand, and gravel deposited by streams. The South Loup River and its tributaries and Wild Horse Creek have been the main contributors. Windblown materials have been mixed with the alluvium in places. Most soils that formed in alluvium lack clearly defined horizons. Most of these soils, such as the Loup, are poorly drained.

Soil material at the base of slopes, brought down from higher elevations through the action of gravity and local wash, is referred to as colluvium. In Logan County, it is generally silty material and not easily distinguished from alluvium and loess. In this county the Hord soils are the major soils that formed in this material.

Climate

Climate has influenced the formation of soils in Logan County, both directly and indirectly. Wind and water help erode away soft rock and transport sediments. Wetting and drying and freezing and thawing contribute to soil formation. Rainfall, temperature, humidity, and length of growing season affect chemical reactions in the soil and influence the amount and kinds of vegetation and other organisms that help in soil formation. Some of these same forces, such as rain and wind, help to destroy the soil.

The average annual precipitation in this county is about 21 inches, and the average annual temperature is approximately 49° F. Most of the precipitation falls during the growing season. This results in a good growth of native grasses. Frost may penetrate to a depth of 2 to 4 feet and remain from 3 to 4 months. Snow cover may be lacking through much of the winter. Temperatures are warm enough to allow decomposition of plant and animal remains but not hot enough to completely oxidize them. This has resulted in the development of a dark surface horizon in all but the very sandy soils.

The humidity generally is low. Wind velocities may be high during much of winter and spring. Droughts are common and last from a few weeks to a few years.

Precipitation has not been great enough for excessive leaching to take place in any but the very sandy soils. The soils that formed in loess show an accumulation of clay in the subsoil and an accumulation of lime in the underlying material.

Plant and animal life

Many living organisms are important to soil formation in Logan County. These animals and plants include bacteria and fungi. The kinds and amounts of vegetation, which are influenced by soil, climate, and drainage, are generally responsible for the amount of organic matter, the color of the surface layer, and the presence of some of the nutrients in the soil. Earthworms, cicadas, and other burrowing animals stir the soil and help keep it open and porous. Bacteria and fungi decompose vegetation, thus releasing nutrients for more plant growth. Certain micro-organisms are able to "fix" free nitrogen into usable forms.

In Logan County the prairie grasses have a great deal of influence on soil formation. Without the stabilizing action of the grasses, the sand dunes would be barren of soil. They also help give the other soils their dark, friable surface layer and return soil nutrients to this layer.

Man has played an important role in the past few decades. He has aided soil formation by controlling grass fires, fertilizing, and, in some cases, cultivating the soil. He has also reversed the process by destroying ground cover by overgrazing and plowing, and thus allowing wind and rain to erode away the surface soil.

Relief

The relief, or the lay of the land, affects the soil by influencing its drainage, erosion, plant cover, and soil temperature. The slopes in Logan County range from less than 1 percent in the stream valleys and on upland tables to more than 30 percent on the steeper dunes and drainage breaks. Soils occurring where slopes face east and north have soil temperatures that are slightly lower than those where slopes face west and south. Differences in elevation are not great enough to seriously affect temperatures.

Soils or land types that have very steep slopes, such as Rough broken land, loess, have a thin, light-colored surface layer and are leached only a little, whereas soils having more gentle slopes, such as the Holdrege, have a thick, dark-colored surface layer and show more leaching, though both formed in similar materials. Erosion from excessive runoff on the very steep slopes has limited soil formation on Rough broken land, loess. Soils occurring in positions that receive additional moisture have a thick, dark-colored profile, have an accumulation of clay in the subsoil, and are generally leached of lime. An example of this is Scott soils. Soils in positions that are affected by a high water table generally have a very dark colored surface layer that is high in organic-matter content. They may be limy or contain soluble salts that are brought upward in the soil solution and precipitated in the upper layers when the soil dries out. Examples of this action are found in the Ord and Loup soils.

Time

The formation of soils has required time for changes to take place in the parent materials. The age of soils is sometimes expressed in the degree of soil development in a soil profile. Soils having little or no soil development are immature, whereas those with well-expressed soil horizons are mature soils, even though the parent materials in which they are formed are of the same age.

Soils in Logan County range from immature to mature. Soils that formed in the Sandhills, such as the Valentine soils, are immature because the dunes have not been stabilized long enough for much soil development. Holdrege soils are an example of more mature soils that show considerable soil development.

Classification of the Soils

Classification consists of an orderly grouping of soils according to a system designed to make it easier to remember soil characteristics and interrelationships. Classification is useful in organizing and applying the results of experience and research. Soils are placed in narrow classes for discussion in detailed soil surveys and for application of knowledge on farms. The thousands of narrow classes are then grouped into progressively fewer and broader classes in successively higher categories, so that information can be applied to large geographic areas.

The system of classifying soils currently used by the National Cooperative Soil Survey was developed in the early sixties (*3*, *5*) and was adopted in 1965. It is under continual study. The system has six categories. Beginning with the most inclusive, these categories are the order, the suborder, the great group, the subgroup, the family, and the series. The criteria for classification are soil properties that are observable or measurable, but the properties are selected so that soils of similar genesis are grouped together. The placement of some soil series in the current system of classification may change as more precise information becomes available. The classification used here was up to date as of March 1973.

Some soils do not fit in a series that has been recognized in the classification system but are named for a series they strongly resemble, because they differ from that series in ways too small to be of consequence in interpreting their usefulness or behavior. Such soils are designated as taxadjuncts to the series for which they are named. In Logan County soils named in the Coly, Holdrege, and Ovina series are taxadjuncts to those series.

Table 9 shows the classification of each soil series of Logan County by family, subgroup, and order, according to the current system.

ORDER.—Ten soil orders are recognized. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate these soil orders are those that tend to give broad climatic groupings of soils. The two exceptions to this, the Entisols and Histosols, occur in many different kinds of climate. Table 9 shows that the two soil orders in Logan County are Entisols and Mollisols.

Entisols are light-colored soils that do not have natural genetic horizons or that have only very weakly expressed beginnings of such horizons. These soils have no traits that reflect soil mixing caused by shrinking and swelling.

Mollisols formed under grass and have a thick, dark-colored surface horizon containing colloids dominated by bivalent cations. The soil material in these soils has not been mixed by shrinking and swelling.

SUBORDER.—Each order is subdivided into suborders, primarily on the basis of those soil characteristics that seem to produce classes with the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders are mainly those that reflect either the presence or absence of waterlogging, or soil differences resulting from the climate or vegetation.

GREAT GROUPS.—Suborders are separated into great groups on the basis of uniformity in the kinds and sequence of major soil horizons and features. The horizons used to make separations are those in which clay, iron, or humus has accumulated or those that have pans that interfere with the growth of roots or movement of water. The features used are the self-mulching properties of clays, soil temperature, major differences in chemical com-

TABLE 9.—*Soils classified according to the current system of classification*

Series	Family	Subgroup	Order
Anselmo	Coarse-loamy, mixed, mesic	Typic Haplustolls	Mollisols.
Coly [1]	Fine-silty, mixed (calcareous), mesic	Typic Ustorthents	Entisols.
Dunday	Sandy, mixed, mesic	Entic Haplustolls	Mollisols.
Els	Mixed, mesic	Aquic Ustipsamments	Entisols.
Elsmere	Sandy, mixed, mesic	Aquic Haplustolls	Mollisols.
Gannett	Coarse-loamy, mixed, mesic	Typic Haplaquolls	Mollisols.
Hall	Fine-silty, mixed, mesic	Pachic Argiustolls	Mollisols.
Hersh	Coarse-loamy, mixed, nonacid, mesic	Typic Ustorthents	Entisols.
Hobbs	Fine-silty, mixed, mesic	Cumulic Haplustolls	Mollisols.
Holdrege [1]	Fine-silty, mixed, mesic	Typic Argiustolls	Mollisols.
Hord	Fine-silty, mixed, mesic	Pachic Haplustolls	Mollisols.
Loup	Sandy, mixed, mesic	Typic Haplaquolls	Mollisols.
Ord	Coarse-loamy, mixed, mesic	Fluvaquentic Haplustolls	Mollisols.
Ovina [1]	Coarse-loamy, mixed, mesic	Aquic Haplustolls	Mollisols.
Scott	Fine, montmorillonitic, mesic	Typic Argialbolls	Mollisols.
Tryon	Mixed, mesic	Typic Psammaquents	Entisols.
Uly	Fine-silty, mixed, mesic	Typic Haplustolls	Mollisols.
Valentine	Mixed, mesic	Typic Ustipsamments	Entisols.
Vetal	Coarse-loamy, mixed, mesic	Pachic Haplustolls	Mollisols.

[1] The soils named in these series in Logan County are taxadjuncts. They are outside the defined range for the series in the following ways:

Soils named in the Coly series are more than 18 percent clay.

Some soils named in the Holdrege series have a thinner, lighter colored A horizon.

Soils named in the Ovina series have a lower water table.

position (mainly calcium, magnesium, sodium, and potassium), and the like. The great group is not shown separately in table 9, because it is the last word in the name of the subgroup.

SUBGROUP.—Great groups are subdivided into subgroups, one representing the central (typic) segment of the group, and others, called intergrades, that have properties of the group and also one or more properties of another great group, suborder, or order. Subgroups may also be made in those instances where soil properties intergrade outside of the range of any other great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the great group.

FAMILY.—Families are distinguished within a subgroup primarily on the basis of properties important to the growth of plants or the behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence.

SERIES.—Series are groups of soils that have major horizons that, except for texture of the surface layer, are similar in important characteristics and in their arrangement within the profile. They are generally given the name of a geographic location near the place where that series was first observed and mapped.

Environmental Factors Affecting Soil Use

This section includes a brief discussion of the relief and drainage, water supply, and climate of Logan County. It also describes briefly the transportation facilities, schools, and trends in soil use.

Cattlemen drifted into the area that is now Logan County about 1876 to make use of the native grasses, and by 1885, when the county was organized, the population was 456. Settlement was speeded by the passage of the Kinkaid Act in 1904, which entitled settlers to 640 acres instead of 160, and by the coming of the Union Pacific Railroad in Stapleton in 1911. The settlers were mainly farmers, however, and they turned many good ranges into blowouts by trying to farm even the sandy soils.

In 1969 the county had 172 farms, and the average size of a farm was 2,291 acres, 156 acres of which was in crops. The total acreage of cropland harvested dropped from 68,175 acres in 1964 to 50,990 in 1969. The irrigated acreage increased from 3,057 in 1959 to 4,410 in 1969, and the number of irrigated farms increased from 29 to 37.

Population reached a recorded peak of 2,014 in 1930. After that it decreased as Kinkaiders sold to ranchers, and the soils were farmed less intensively. This trend was most evident in the Sandhills in the northern part of the county. Population in 1960 was 1,108, and by 1970 it was 991. A grade school and county high school are located at Stapleton, the county seat, and there are a few small grade schools in rural areas.

U.S. Highway 83 passes through Logan County in a north-south direction. The principal east-west highway that serves the county is State Highway 92, located in the southern part.

Transporting produce, especially cattle, to market has always been a problem. There are practically no local markets for produce. Omaha, the nearest large market, is about 225 road miles away. Most cattle and much of the grain are shipped by truck. Local roads have been improved to allow trucks to load cattle at the ranch or community loading pens. The distance from Stapleton to Interstate 80 is about 30 miles. Very little produce except grain is now shipped by rail from Stapleton. Nearly all the hay and much of the grain is fed locally to livestock.

Relief and Drainage

The use and potential use of the soils of Logan County are influenced by, among other things, the relief, or lay of the land, and drainage, both natural and artificial. The highest point in the county is about 3,180 feet in elevation, and the lowest point is about 2,730 feet.

The Sandhills part of the county, which is rolling to hilly, is used mostly as range. Many of the Sandhill valleys and the poorly drained parts of the South Loup Valley are used as hayland. The high water table is beneficial to the production of meadow grasses. Some areas have been partially drained to eliminate or decrease marshy areas. Suitable outlets generally are not available for complete drainage.

The tablelands in the southern part of the county have some areas, several hundred acres in size, that are nearly level to very gently sloping. These are areas of well-drained soils that have a potential for more intensive use.

The deeply dissected, excessively drained area between the tablelands and the South Loup Valley is used mostly for range. It has good potential for wildlife habitat and recreation.

Water Supply

A few lakes and marshes are in the valley of the South Loup River and the valleys of the Sandhills. Little use is made of these shallow waters except as wildlife habitat. There is some irrigation from the South Loup River, but the flow is too small for much additional development.

There is an abundance of good-quality underground water for domestic and livestock use. Deep-well irrigation has been developed on some of the tablelands in the valley of the South Loup River, and in some of the valleys of the Sandhills. There is potential for considerably more irrigation. Much of the tablelands is suitable for gravity methods of irrigation, and some of the sandy valleys have potential for sprinkler irrigation. Caution should be used to prevent pollution of streams and of the ground water beneath sandy soils.

Climate [8]

The climate of Logan County is distinctly continental. Rainfall is light, winters are cold, summers are warm, and there are frequent, rather large changes in weather from day to day and from season to season. There are no bodies of water in the county large enough to have an effect on the general climate.

The Rocky Mountains have a pronounced warming and drying effect on the air that reaches this area from the west. The mountains directly to the west do not form a solid ridge like those to the southwest, and strong westerly winds blow frequently through the low areas in winter and early in spring. There are no climatic barriers in the other directions, and cold air masses from Canada move freely into the area with little change enroute. Most of the precipitation that falls here originates in the Gulf of Mexico and is carried northward on the west side of the Bermuda High. More than three-fourths of the annual precipitation falls during the 6-month period from April through September, when the prevailing winds are southerly. Large variations in the amount of summer precipitation occur according to the path taken by the moisture-laden winds from the gulf. In some years the path of these winds is farther to the east than in others, and drought conditions develop in Logan County. This variation in rainfall is indicated in table 10. For instance, on an average, one July in 10 has no more than 0.6 inch of moisture, but one July in 10 receives more than seven times that amount.

Precipitation early in spring is generally slow and steady and is usually well distributed. As spring and summer advance, however, more and more of the precipitation falls during erratic thundershower activity and the distribution may be very irregular. These thunderstorms in spring and early in summer become severe at times and may be accompanied by local downpours, hail, and damaging winds. The hail seldom does great damage to the range that is dominant in the county. Damage to hay and grain crops within the main hail strips is severe, but the area covered is small. Late in summer and in fall, the showers gradually become lighter and farther apart. Fall weather is characterized by an abundance of sunshine, mild days, and cool nights.

Winter precipitation is generally light, and practically all of it falls as snow, although some winters have one or more periods of freezing rain. Snow is often accompanied by strong northerly winds and a change to colder weather. Average annual snowfall is about 32 inches, but there is considerable variation from year to year. Frequently the snow melts before the next snowfall arrives, and during an average winter there are only 47 days when the ground is covered by snow.

Average daily maximum and minimum temperatures can be determined from table 10. The daily range in temperature is large in summer. The days are quite warm, but the nights are generally cool. Only in July does the nighttime temperature average as high as 60 degrees. The frequency of very high and very low temperatures also is indicated in the table. For example, the table shows that in 2 years in 10 there are at least 4 days in July when the temperature rises to 100° F. or higher. Likewise, it shows that in 2 years in 10 the temperature falls below 50° on 4 nights in July. The average yearly high is 104°, and the average annual low is −18°. Temperatures have been recorded in Stapleton as high as 114° in 1954 and as low as −30° in 1930.

The probabilities of freezing temperatures occurring after specified dates in spring or before certain dates in fall are given in table 11. For example, in half of the years the air temperature can be expected to fall below 32° after May 9 (average date of last freeze) and in 1 year in 10 there will be a freeze as late as May 25. In fall a freeze can be expected before September 15 in 1 year out of 10. In 5 years out of 10, a freeze can be expected before September 29 (average date of first freeze in fall).

Annual free-water evaporation from shallow lakes averages about 44 inches, and approximately 77 percent of the total occurs during the 6-month period, May through October.

[8] By Richard E. Myers, climatologist for Nebraska, National Weather Service, U.S. Department of Commerce.

TABLE 10.—*Temperature and precipitation*

[All data at Stapleton; period of record is 1939 to 1968 for average temperature and precipitation; 1903 to 1963 for maximum and minimum temperatures; 1922 to 1968 for precipitation extremes; and 1933 to 1962 for snow cover]

Month	Temperature				Precipitation				
	Average daily maximum	Average daily minimum	Two years in 10 will have at least 4 days with—		Average monthly total	One year in 10 will have—		Days with 1 inch or more snow cover	Average depth of snow on days with snow cover
			Maximum temperature equal to or higher than—	Minimum temperature equal to or lower than—		Equal to or less than—	Equal to or more than—		
	°F.	°F.	°F.	°F.	Inches	Inches	Inches	Number	Inches
January	37	11	57	−14	0.5	(1)	1.0	11	5
February	41	15	62	− 8	.6	0.1	1.2	12	5
March	48	22	70	2	1.2	.3	2.3	10	4
April	62	34	82	21	2.1	.6	3.9	2	3
May	72	45	88	32	3.5	1.1	6.6	(2)	2
June	81	55	97	43	3.8	1.4	5.4	0	----------
July	89	60	100	50	2.5	.6	4.6	0	----------
August	88	58	99	48	2.0	.7	4.0	0	----------
September	78	48	95	34	2.2	.5	4.7	0	----------
October	68	37	86	22	1.1	.1	2.4	(2)	3
November	51	23	70	7	.6	(1)	1.8	3	3
December	40	15	59	− 7	.6	(1)	1.1	9	4
Year	63	35	[3] 104	[4] −18	20.7	13.5	27.3	47	4

[1] Amount too small to measure.
[2] Less than one-half day.
[3] Average annual highest temperature.
[4] Average annual lowest temperature.

TABLE 11.—*Probabilities of last freezing temperatures in spring and first in fall*

[All data at Stapleton]

Probability	Dates for given probability and temperature				
	16° F.	20° F.	24° F.	28° F.	32° F.
Spring:					
1 year in 10 later than	April 16	April 23	May 5	May 16	May 25
2 years in 10 later than	April 11	April 18	April 29	May 12	May 20
5 years in 10 later than	April 1	April 7	April 19	May 1	May 9
Fall:					
1 year in 10 earlier than	October 20	October 15	October 6	September 25	September 15
2 years in 10 earlier than	October 26	October 20	October 11	September 30	September 20
5 years in 10 earlier than	November 6	October 30	October 21	October 11	September 29

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Glossary

Alkali soil. Generally, a highly alkaline soil. Specifically, an alkali soil has so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that the growth of most crop plants is low from this cause.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Available water capacity (also termed available moisture capacity) The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. In this soil survey, available water capacity is given to a depth of 60 inches. The classes are (1) *high*, more than 9 inches; (2) *moderate*, 6 to 9 inches; (3) *low*, 3 to 6 inches; and (4) *very low*, 0 to 3 inches.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Catsteps. Very small, irregular terraces on steep hillsides, especially pastures, formed by cattle tracks or slippage of saturated soil.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Claypan. A compact, slowly permeable soil horizon that contains more clay than the horizon above and below it. A claypan is commonly hard when dry and plastic or stiff when wet.

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds, or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Depth, soil. The total thickness of weathered soil material over mixed sand and gravel or bedrock. In this soil survey, the classes of soil depth are (1) *deep*, more than 40 inches; (2) *moderately deep*, 20 to 40 inches; (3) *shallow*, 10 to 20 inches; and (4) *very shallow*, 0 to 10 inches.

Drainage class (natural). Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and have mottling in the lower B and C horizons.

Somewhat poorly drained soils are wet for significant periods but not all the time, and some soils commonly have mottling at a depth below 6 to 16 inches.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

Gravity irrigation. Method of irrigation where water is spread across the field by gravity down the slope.

Hayland. Land which is in permanent vegetation, usually grass and legumes, used primarily for hay.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Leaching (soil). The removal of soluble materials from soils or other material by percolating water.

Loess. Fine-grained material, dominantly of silt-sized particles, that has been deposited by wind.

Microrelief. Minor surface configurations of the land.

Mottling, soil. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance—*few*, *common*, and *many;* size—*fine*, *medium*, and *coarse;* and contrast—*faint*, *distinct*, and *prominent*. The size measurements are these: *fine*, less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium*, ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse*, more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Parent material. Disintegrated and partly weathered rock from which soil has formed.

Permanent grasses. Any perennial grasses adapted to the local climate.

Permeability, soil. The quality that enables the moist soil to transmit water or air. In this soil survey, the classes of permeability, in inches of water per hour, are (1) *very slow*, less than 0.06 inch; (2) *slow*, 0.06 to 0.2 inch; (3) *moderately slow*, 0.2 to 0.6 inch; (4) *moderate*, 0.6 inch to 2.0 inches; (5) *moderately rapid*, 2.0 to 6.0 inches; (6) *rapid*, 6.0 to 20 inches; and (7) *very rapid*, more than 20 inches.

Range site. An area of range where climate, soil, and relief are sufficiently uniform to produce a distinct kind of climax vegetation.

Relief. The elevations or inequalities of a land surface, considered collectively.

Sand. Individual rock or mineral fragments in a soil that range in diameter from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Stripcropping. Growing crops in a systematic arrangement of strips, or bands, to serve as vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand*, *loamy sand*, *sandy loam*, *loam*, *silt loam*, *silt*, *sandy clay loam*, *clay loam*, *silty clay loam*, *sandy clay*, *silty clay*, and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

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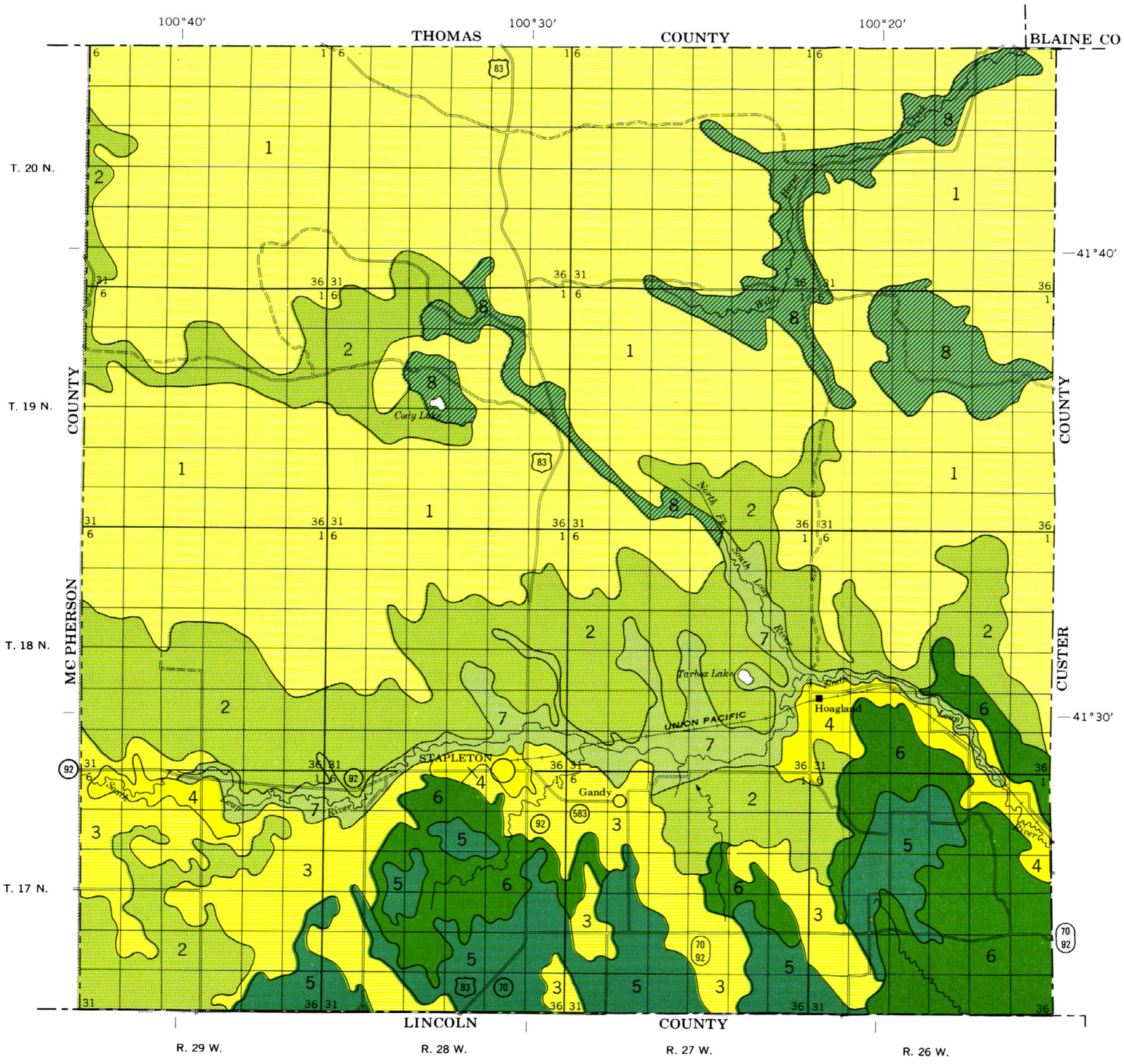

SOIL ASSOCIATIONS *

1. Valentine association: Rolling and hilly, excessively drained, sandy soils on sandhills
2. Valentine-Dunday association: Nearly level to rolling, excessively drained and somewhat excessively drained, sandy soils on sandhills and in valleys
3. Valentine-Hersh association: Nearly level to gently rolling, excessively drained to well-drained, sandy and loamy soils on uplands and in valleys
4. Ovina-Anselmo association: Nearly level and very gently sloping, moderately well drained and well drained, loamy soils on stream terraces
5. Holdrege-Hord association: Nearly level to strongly sloping, well-drained, silty soils on uplands
6. Uly-Hersh-Coly association: Strongly sloping to steep, well-drained, silty and loamy soils on uplands
7. Gannett-Elsmere association: Nearly level, poorly drained and somewhat poorly drained, sandy and loamy soils on bottom lands and stream terraces
8. Valentine-Els association: Nearly level to rolling, excessively drained and somewhat poorly drained, sandy soils on sandhills and in valleys

* Texture refers to surface layer of major soils.

Compiled 1972

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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

UNIVERSITY OF NEBRASKA, CONSERVATION AND SURVEY DIVISION

GENERAL SOIL MAP

LOGAN COUNTY, NEBRASKA

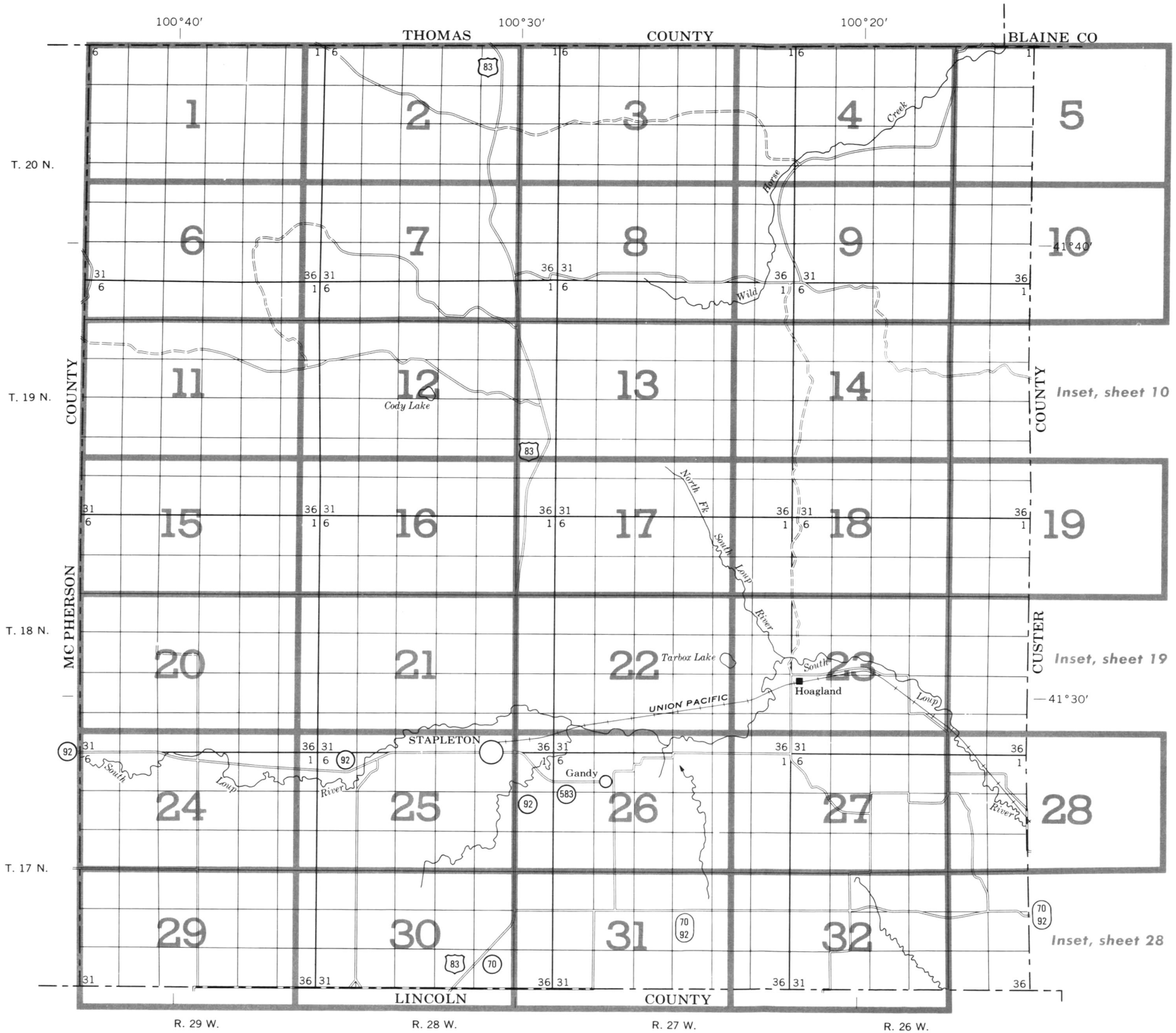
Scale 1:190,080

1 0 1 2 3 4 Miles

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.



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INDEX TO MAP SHEETS

LOGAN COUNTY, NEBRASKA

Scale 1:190,080

1 0 1 2 3 4 Miles

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOGAN COUNTY, NEBRASKA

UNIVERSITY OF NEBRASKA, CONSERVATION AND SURVEY DIVISION

SOIL LEGEND

The first capital letter is the initial one of the soil name. A second capital letter, A, B, C, D, E, F, or G, shows the slope. Most symbols without a slope letter are those of nearly level soils, but some are for land types that have a considerable range of slope. A final number, 2 or 3, in the symbol shows that the soil is eroded or severely eroded.

SYMBOL	NAME
AnB	Anselmo fine sandy loam, 0 to 3 percent slopes
AnC	Anselmo fine sandy loam, 3 to 5 percent slopes
AnD	Anselmo fine sandy loam, 5 to 11 percent slopes
AtA	Anselmo fine sandy loam, terrace, 0 to 1 percent slopes
Bo	Blown-out land
CoG	Coly loam, 15 to 31 percent slopes
CuF	Coly and Uly silt loams, 11 to 15 percent slopes
DvB	Dunday-Valentine loamy fine sands, 0 to 3 percent slopes
DvD	Dunday-Valentine loamy fine sands, 3 to 9 percent slopes
Ee	Els and Elsmere fine sands
Ga	Gannett fine sandy loam
Ha	Hall silt loam
HeC	Hersh fine sandy loam, 3 to 5 percent slopes
HfB	Hersh and Anselmo fine sandy loams, 0 to 3 percent slopes
HgD	Hersh and Valentine soils, 5 to 11 percent slopes
HgG	Hersh and Valentine soils, 11 to 31 percent slopes
HhA	Hobbs silt loam, 0 to 1 percent slopes
HhB	Hobbs silt loam, 1 to 3 percent slopes
HkC	Holdrege fine sandy loam, 2 to 4 percent slopes, overblown
HoC	Holdrege silt loam, 3 to 5 percent slopes
HoC2	Holdrege silt loam, 3 to 5 percent slopes, eroded
HoD	Holdrege silt loam, 5 to 11 percent slopes
HoD3	Holdrege silt loam, 5 to 11 percent slopes, severely eroded
HpB	Holdrege-Hord silt loams, 0 to 3 percent slopes
HrA	Hord silt loam, 0 to 1 percent slopes
HrB	Hord silt loam, 1 to 3 percent slopes
HrC	Hord silt loam, 3 to 5 percent slopes
Lo	Loup fine sandy loam
Ma	Marsh
Or	Ord fine sandy loam
Os	Ord fine sandy loam, alkali
Ov	Ovina fine sandy loam
Rb	Rough broken land, loess
Sc	Scott soils
Tn	Tryon loamy fine sand
UaA	Uly silt loam, 0 to 2 percent slopes
UcG	Uly-Coly silt loams, 15 to 31 percent slopes
UhD	Uly-Holdrege silt loams, 5 to 11 percent slopes
UhF	Uly-Holdrege silt loams, 11 to 15 percent slopes
VaB	Valentine fine sand, nearly level
VaF	Valentine fine sand, rolling
VaG	Valentine fine sand, hilly
VbB	Valentine loamy fine sand, nearly level
VbE	Valentine loamy fine sand, rolling
VcG	Valentine complex, hilly
Vt	Vetal fine sandy loam
Wa	Wet alluvial land

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads
- Divided
- Good motor
- Poor motor
- Trail

Highway markers
- National Interstate
- U. S.
- State or county

Railroads
- Single track
- Multiple track
- Abandoned

Bridges and crossings
- Road
- Trail
- Railroad
- Ferry (FY)
- Ford (FORD)
- Grade
- R. R. over
- R. R. under

Buildings
- School
- Church

Mine and quarry

Gravel pit

Power line

Pipeline

Cemetery

Dams

Levee

Tanks

Well, oil or gas

Forest fire or lookout station

Windmill

Located object

BOUNDARIES

- National or state
- County
- Minor civil division
- Reservation
- Land grant
- Small park, cemetery, airport
- Land survey division corners

DRAINAGE

Streams, double-line
- Perennial
- Intermittent

Streams, single-line
- Perennial
- Intermittent
- Unclassified

Canals and ditches

Well, irrigation

Well, artesian

Lakes and ponds
- Perennial (water, w)
- Intermittent (int)

Spring

Marsh or swamp

Wet spot

Drainage end or alluvial fan

RELIEF

Escarpments
- Bedrock
- Other

Short steep slope

Prominent peak

Depressions

	Large	Small
Crossable with tillage implements		
Not crossable with tillage implements		
Contains water most of the time		

SOIL SURVEY DATA

- Soil boundary and symbol (Dx)
- Gravel
- Stoniness: Stony, Very stony
- Rock outcrops
- Chert fragments
- Clay spot
- Sand spot
- Gumbo or scabby spot
- Made land
- Severely eroded spot
- Blowout, wind erosion
- Gully
- **Saline or alkali spot**

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and that of the soil series to which the mapping unit belongs. In referring to a capability unit, a range site, or a windbreak suitability group, read the introduction to the section it is in for general information about its management. Windbreak suitability groups are discussed on pages 41 and 42. Other information is given in tables as follows:

Acreage and extent, table 1, page 7.
Predicted yields, table 2, page 35.

Wildlife, tables 4 and 5, page 44.
Engineering uses of the soils, tables 6, 7, and 8, pages 46 through 61.

Map symbol	Mapping unit	Page	Capability unit Dryland Symbol	Dryland Page	Capability unit Irrigated Symbol	Irrigated Page	Range site Name	Range site Page	Windbreak suitability group Name
AnB	Anselmo fine sandy loam, 0 to 3 percent slopes	8	IIIe-3	29	IIe-31	29	Sandy	38	Sandy
AnC	Anselmo fine sandy loam, 3 to 5 percent slopes	8	IIIe-31	30	IIIe-3	30	Sandy	38	Sandy
AnD	Anselmo fine sandy loam, 5 to 11 percent slopes	8	IVe-3	30	IVe-3	30	Sandy	38	Sandy
AtA	Anselmo fine sandy loam, terrace, 0 to 1 percent slopes	9	IIe-3	29	IIe-3	29	Sandy	38	Sandy
Bo	Blown-out land	9	VIIe-5	34	------	--	Sands	38	Very Sandy
CoG	Coly loam, 15 to 31 percent slopes	9	VIe-8	33	------	--	Limy Upland	40	Silty to Clayey
CuF	Coly and Uly silt loams, 11 to 15 percent slopes	10	VIe-8	33	------	--	----------	--	Silty to Clayey
	Coly part	--	------	--	------	--	Limy Upland	40	----------
	Uly part	--	------	--	------	--	Silty	40	----------
DvB	Dunday-Valentine loamy fine sands, 0 to 3 percent slopes	10	IVe-5	31	IVe-5	31	Sandy	38	Sandy
DvD	Dunday-Valentine loamy fine sands, 3 to 9 percent slopes	11	VIe-5	33	------	--	Sands	38	Very Sandy
Ee	Els and Elsmere fine sands	12	VIw-5	34	IVw-5	34	Subirrigated	36	Moderately Wet
Ga	Gannett fine sandy loam	13	Vw-3	32	------	--	Subirrigated	36	Very Wet
Ha	Hall silt loam	13	IIc-1	28	I-1	28	Silty Lowland	37	Silty to Clayey
HeC	Hersh fine sandy loam, 3 to 5 percent slopes	14	IIIe-31	30	IIIe-3	30	Sandy	38	Sandy
HfB	Hersh and Anselmo fine sandy loams, 0 to 3 percent slopes	14	IIIe-3	29	IIe-31	29	Sandy	38	Sandy
HgD	Hersh and Valentine soils, 5 to 11 percent slopes	14	IVe-3	30	IVe-3	30	----------	--	----------
	Hersh soil	--	------	--	------	--	Sandy	38	Sandy
	Valentine soil	--	------	--	------	--	Sands	38	Very Sandy
HgG	Hersh and Valentine soils, 11 to 31 percent slopes	14	VIe-3	33	------	--	----------	--	----------
	Hersh soil	--	------	--	------	--	Sandy	38	Sandy
	Valentine soil	--	------	--	------	--	Sands	38	Very Sandy
HhA	Hobbs silt loam, 0 to 1 percent slopes	15	IIc-1	28	I-1	28	Silty Lowland	37	Silty to Clayey
HhB	Hobbs silt loam, 1 to 3 percent slopes	15	IIe-1	28	IIe-1	28	Silty Lowland	37	Silty to Clayey
HkC	Holdrege fine sandy loam, 2 to 4 percent slopes, overblown	16	IIIe-31	30	IIIe-3	30	Sandy	38	Sandy
HoC	Holdrege silt loam, 3 to 5 percent slopes	16	IIIe-1	29	IIIe-1	29	Silty	40	Silty to Clayey
HoC2	Holdrege silt loam, 3 to 5 percent slopes, eroded	16	IIIe-1	29	IIIe-1	29	Silty	40	Silty to Clayey
HoD	Holdrege silt loam, 5 to 11 percent slopes	17	IVe-1	30	IVe-1	30	Silty	40	Silty to Clayey
HoD3	Holdrege silt loam, 5 to 11 percent slopes, severely eroded	17	IVe-8	31	IVe-12	31	Silty	40	Silty to Clayey
HpB	Holdrege-Hord silt loams, 0 to 3 percent slopes	17	IIe-1	28	IIe-1	28	Silty	40	Silty to Clayey
HrA	Hord silt loam, 0 to 1 percent slopes	17	IIc-1	28	I-1	28	Silty Lowland	37	Silty to Clayey
HrB	Hord silt loam, 1 to 3 percent slopes	18	IIe-1	28	IIe-1	28	Silty	40	Silty to Clayey
HrC	Hord silt loam, 3 to 5 percent slopes	18	IIIe-1	29	IIIe-1	29	Silty	40	Silty to Clayey
Lo	Loup fine sandy loam	18	Vw-3	32	------	--	Subirrigated	36	Very Wet
Ma	Marsh	18	VIIIw-7	34	------	--	----------	--	Undesirable
Or	Ord fine sandy loam	19	IIw-6	29	IIw-6	29	Subirrigated	36	Moderately Wet
Os	Ord fine sandy loam, alkali	19	IVs-1	31	IVs-1	31	Subirrigated	36	Moderately Saline or Alkali
Ov	Ovina fine sandy loam	20	IIe-3	29	IIe-3	29	Sandy Lowland	37	Sandy
Rb	Rough broken land, loess	20	VIIe-7	34	------	--	----------	--	Undesirable
	Very steep part	--	------	--	------	--	Thin loess	40	----------
	Steep part	--	------	--	------	--	Silty	40	----------
Sc	Scott soils	21	IVw-2	32	------	--	Clayey Overflow	37	Undesirable
Tn	Tryon loamy fine sand	21	Vw-3	32	------	--	Subirrigated	36	Very Wet
UaA	Uly silt loam, 0 to 2 percent slopes	22	IIe-1	28	IIe-1	28	Silty	40	Silty to Clayey
UcG	Uly-Coly silt loams, 15 to 31 percent slopes	23	VIe-1	32	------	--	----------	--	Silty to Clayey
	Uly soil	--	------	--	------	--	Silty	40	----------
	Coly soil	--	------	--	------	--	Limy Upland	40	----------
UhD	Uly-Holdrege silt loams, 5 to 11 percent slopes	23	IVe-1	30	IVe-1	30	Silty	40	Silty to Clayey
UhF	Uly-Holdrege silt loams, 11 to 15 percent slopes	23	VIe-1	32	------	--	Silty	40	Silty to Clayey
VaB	Valentine fine sand, nearly level	23	VIe-51	33	IVe-51	33	Sandy	38	Very Sandy
VaF	Valentine fine sand, rolling	23	VIe-5	33	------	--	Sands	38	Very Sandy
VaG	Valentine fine sand, hilly	24	VIIe-5	34	------	--	Choppy Sands	39	Very Sandy
VbB	Valentine loamy fine sand, nearly level	24	IVe-5	31	IVe-5	31	Sandy	38	Sandy
VbE	Valentine loamy fine sand, rolling	24	VIe-5	33	------	--	Sands	38	Very Sandy
VcG	Valentine complex, hilly	24	VIIe-5	34	------	--	----------	--	Very Sandy
	Rolling part	--	------	--	------	--	Sands	38	----------
	Hilly part	--	------	--	------	--	Choppy Sands	39	----------
Vt	Vetal fine sandy loam	25	IIe-3	29	IIe-3	29	Sandy	38	Sandy
Wa	Wet alluvial land	25	Vw-7	32	------	--	Wet Land	36	Very Wet

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Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

LOGAN COUNTY, NEBRASKA NO. 1

R. 29 W.

THOMAS COUNTY

MC PHERSON COUNTY

T. 20 N.

1 670 000 FEET

1 690 000 FEET

1 740 000 FEET

1 750 000 FEET

(Joins sheet 2)

(Joins sheet 6)

N

Scale 1:24 000

2 Miles 10 000 Feet 5 000

N

2 Miles 10 000 Feet

1 5 000

Scale 1:24 000

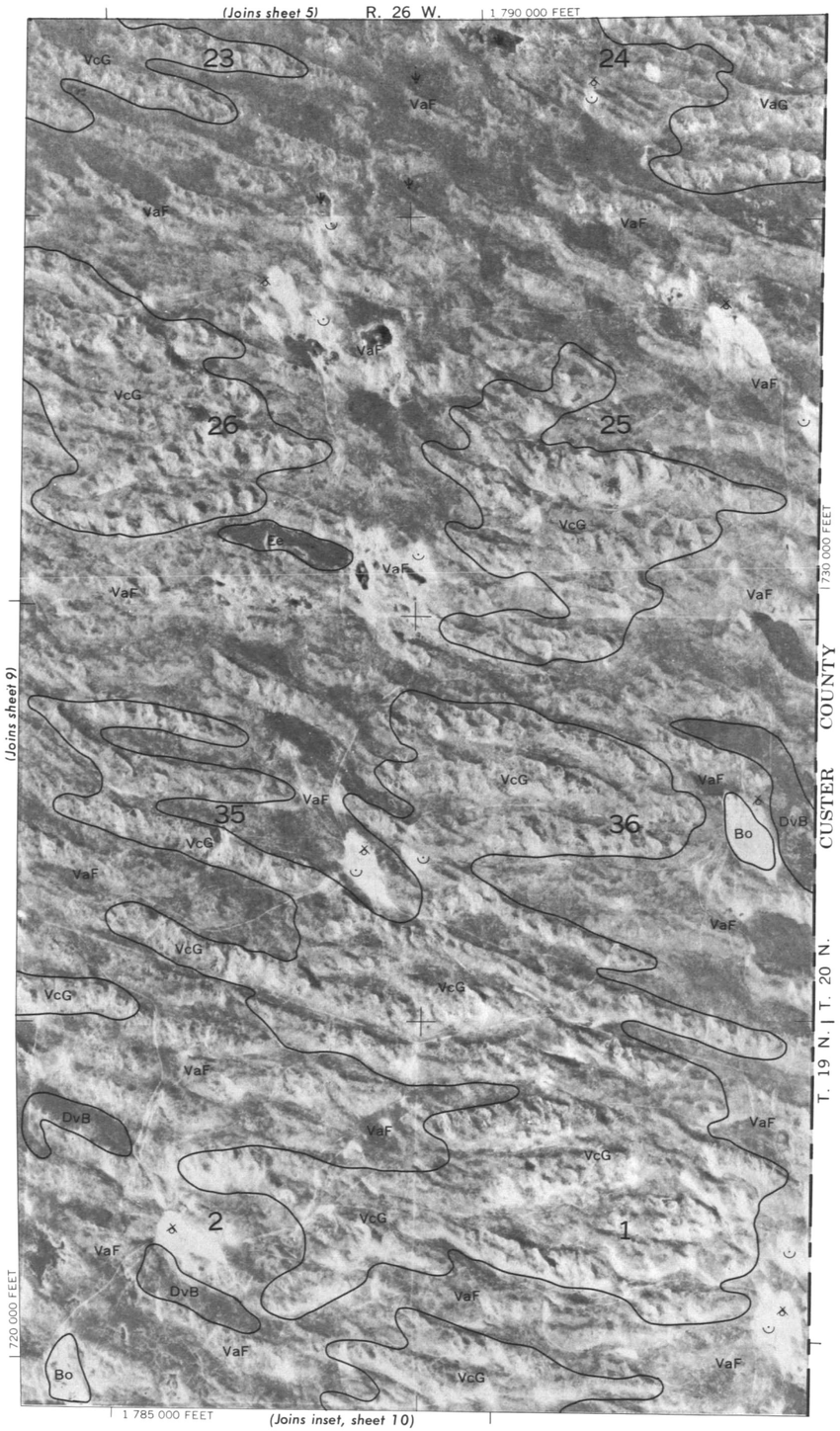
0 0

¼ 1 000 2 000

½ 3 000

¾ 4 000

1 5 000



5 000 AND 10 000-FOOT GRID TICKS

5 000 AND 10 000-FOOT GRID TICKS

LOGAN COUNTY, NEBRASKA NO. 10

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

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LOGAN COUNTY, NEBRASKA NO. 11

1 670 000 FEET

720 000 FEET

R. 29 W.

(Joins sheet 6)

T. 19 N.

MC PHERSON COUNTY

710 000 FEET

(Joins sheet 12)

1 690 000 FEET

(Joins sheet 15)

11

N

2 Miles

10 000 Feet

Scale 1:24 000

1 5 000 0

¼ 1 000 0

½ 2 000 3 000

¾ 4 000 5 000

N

R. 29 W. | R. 28 W.

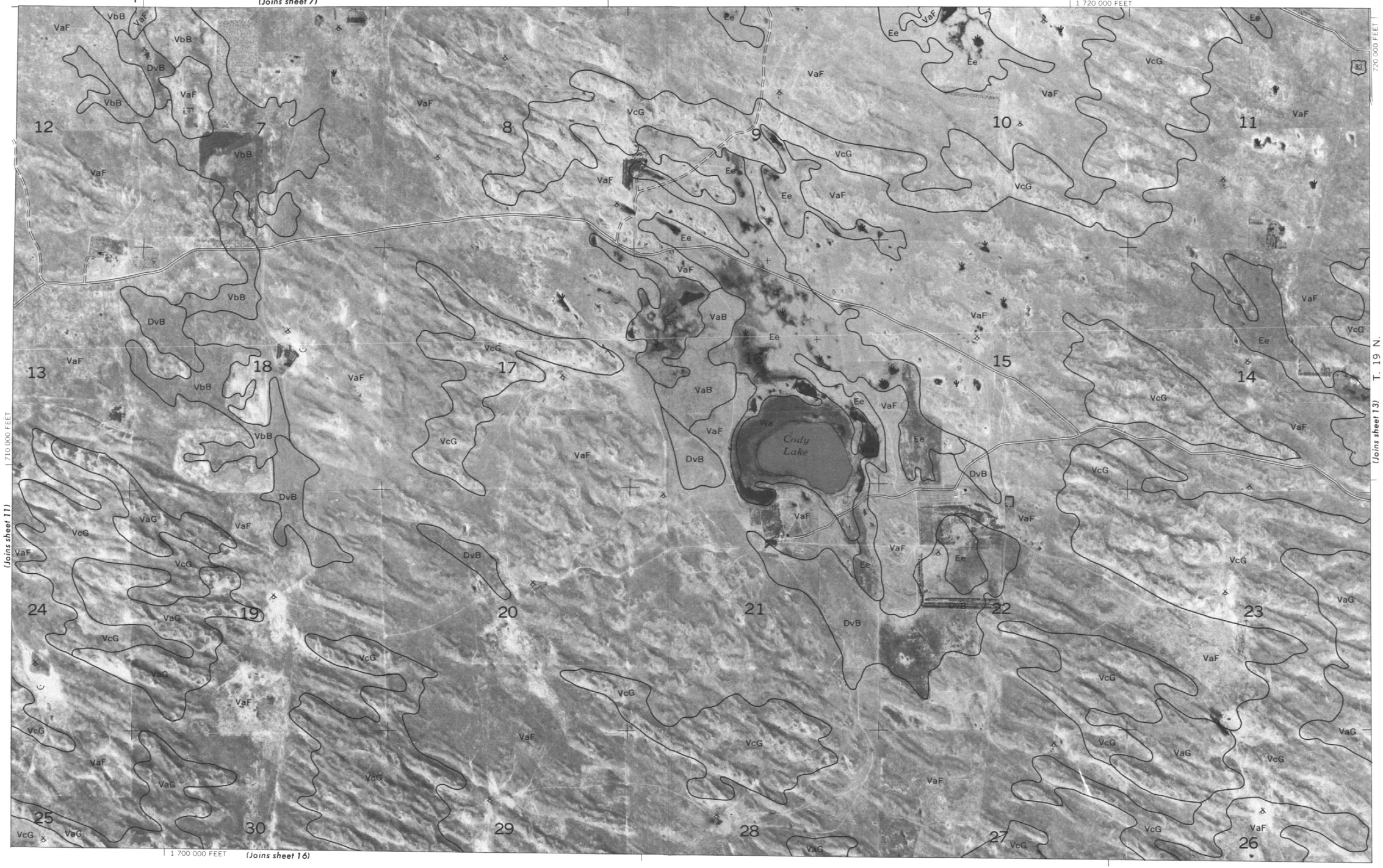
(Joins sheet 7)

1 720 000 FEET

720 000 FEET

T. 19 N.

(Joins sheet 13)



(Joins sheet 11)

710 000 FEET

1 700 000 FEET

(Joins sheet 16)

2 Miles

10 000 Feet

Scale 1:24 000

1 5 000 0 ¼ 1 000 ½ 2 000 ¾ 4 000 1 5 000 0 ½ 3 000

LOGAN COUNTY, NEBRASKA NO. 12

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

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Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

LOGAN COUNTY, NEBRASKA NO. 13

13

N

R. 28 W. | 1 730 000 FEET | R. 27 W.

720 000 FEET

T. 19 N.

705 000 FEET

(Joins sheet 8)

(Joins sheet 12)

(Joins sheet 14)

(Joins sheet 17)

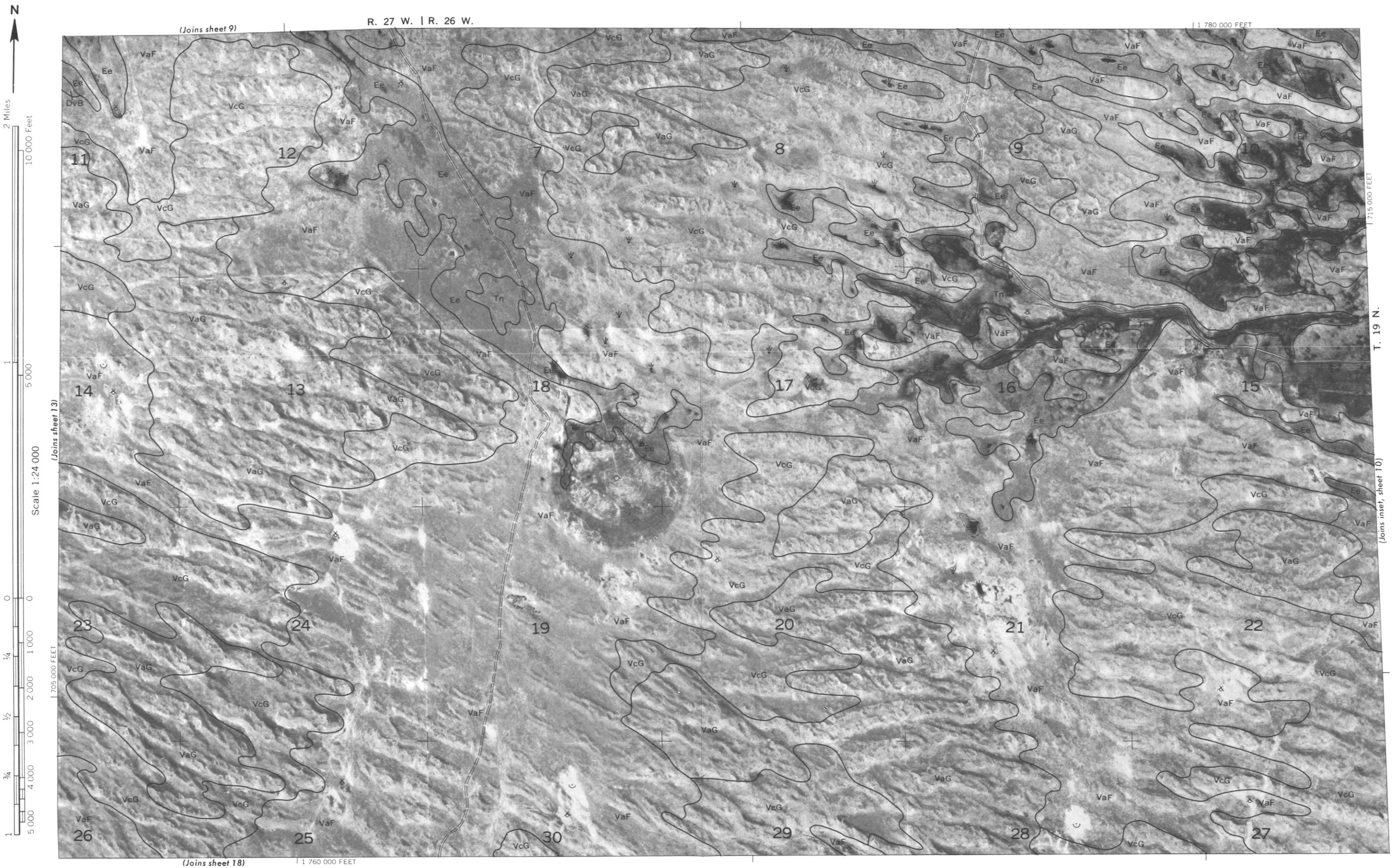
1 750 000 FEET

2 Miles

10 000 Feet

5 000

Scale 1:24 000



LOGAN COUNTY, NEBRASKA NO. 14

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.

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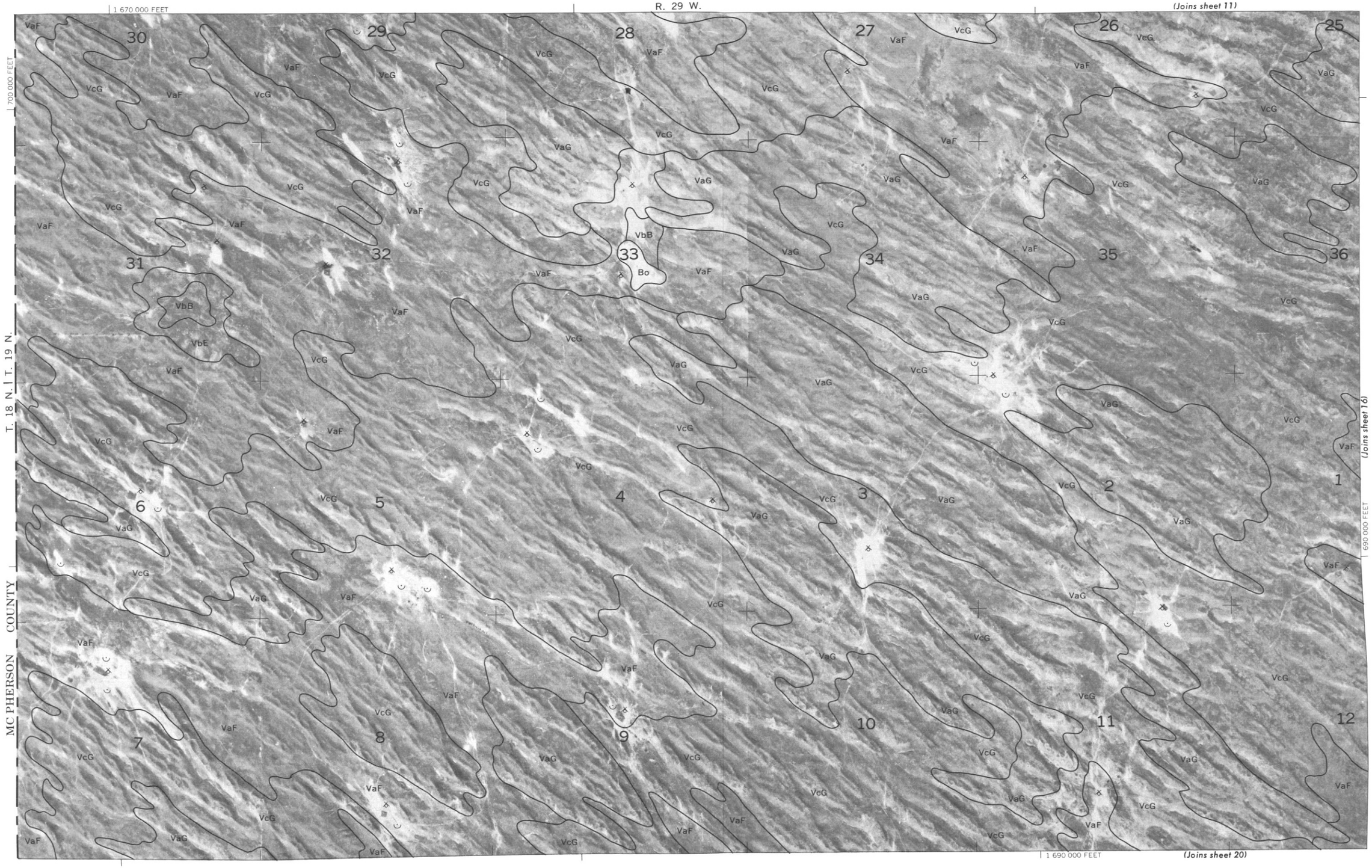
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

LOGAN COUNTY, NEBRASKA NO. 15



15

N

2 Miles

10 000 Feet

Scale 1:24 000

1 5 000 0

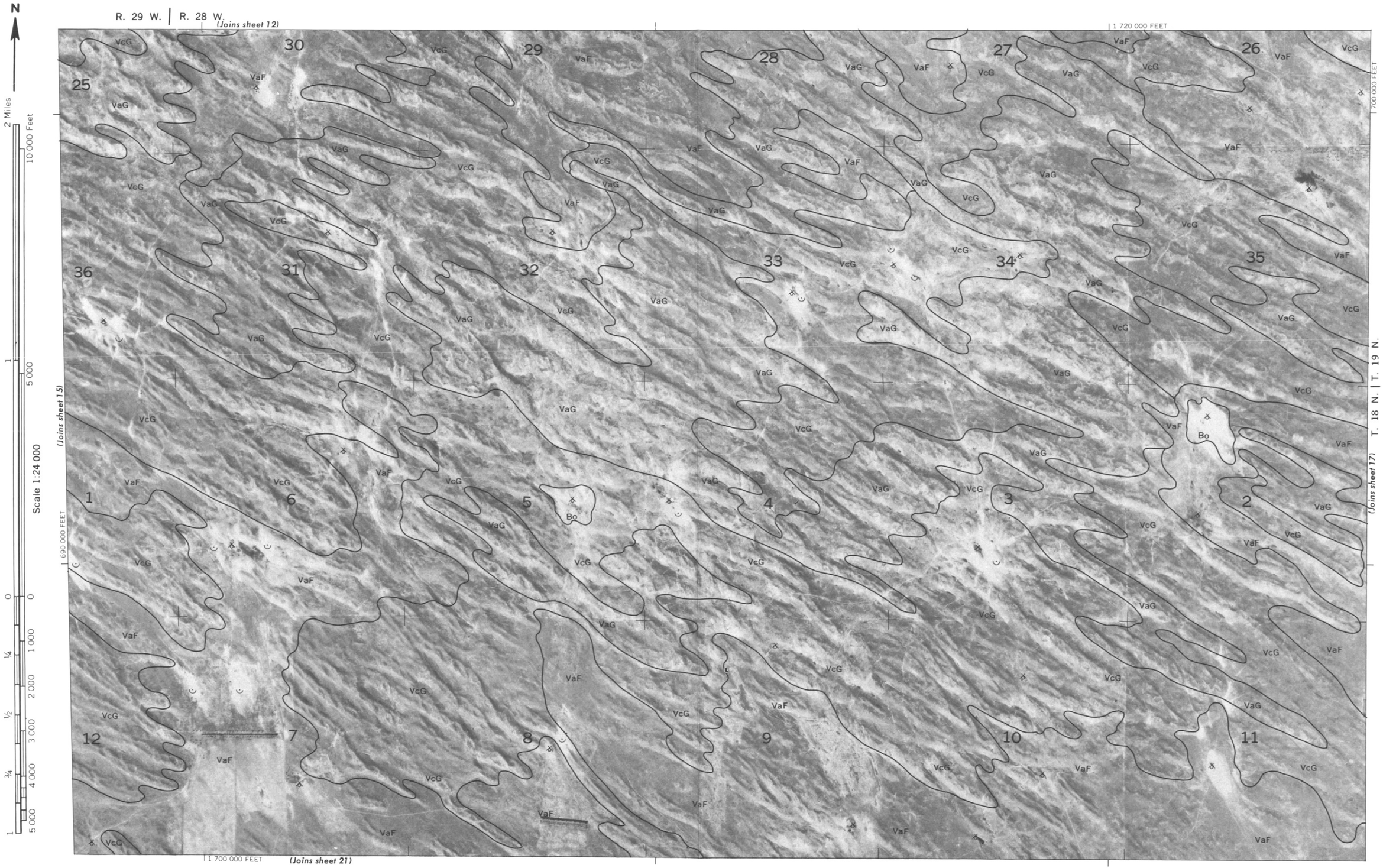
¼ 1 000 0

½ 2 000

¾ 3 000

1 4 000

1 5 000



2 Miles 10 000 Feet

Scale 1:24 000

1 5 000 0 1 000 2 000 3 000 4 000 5 000

1/4 0 1/2 3/4 1

LOGAN COUNTY, NEBRASKA NO. 16

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

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Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

LOGAN COUNTY, NEBRASKA NO. 17

1 730 000 FEET | R. 28 W. | R. 27 W.

700 000 FEET

T. 18 N. | T. 19 N.

(Joins sheet 16)

(Joins sheet 13)

(Joins sheet 18)

(Joins sheet 22)

1 750 000 FEET

690 000 FEET

17

N

2 Miles

10 000 Feet

5 000

Scale 1:24 000

1 0 0

¼ 1 000

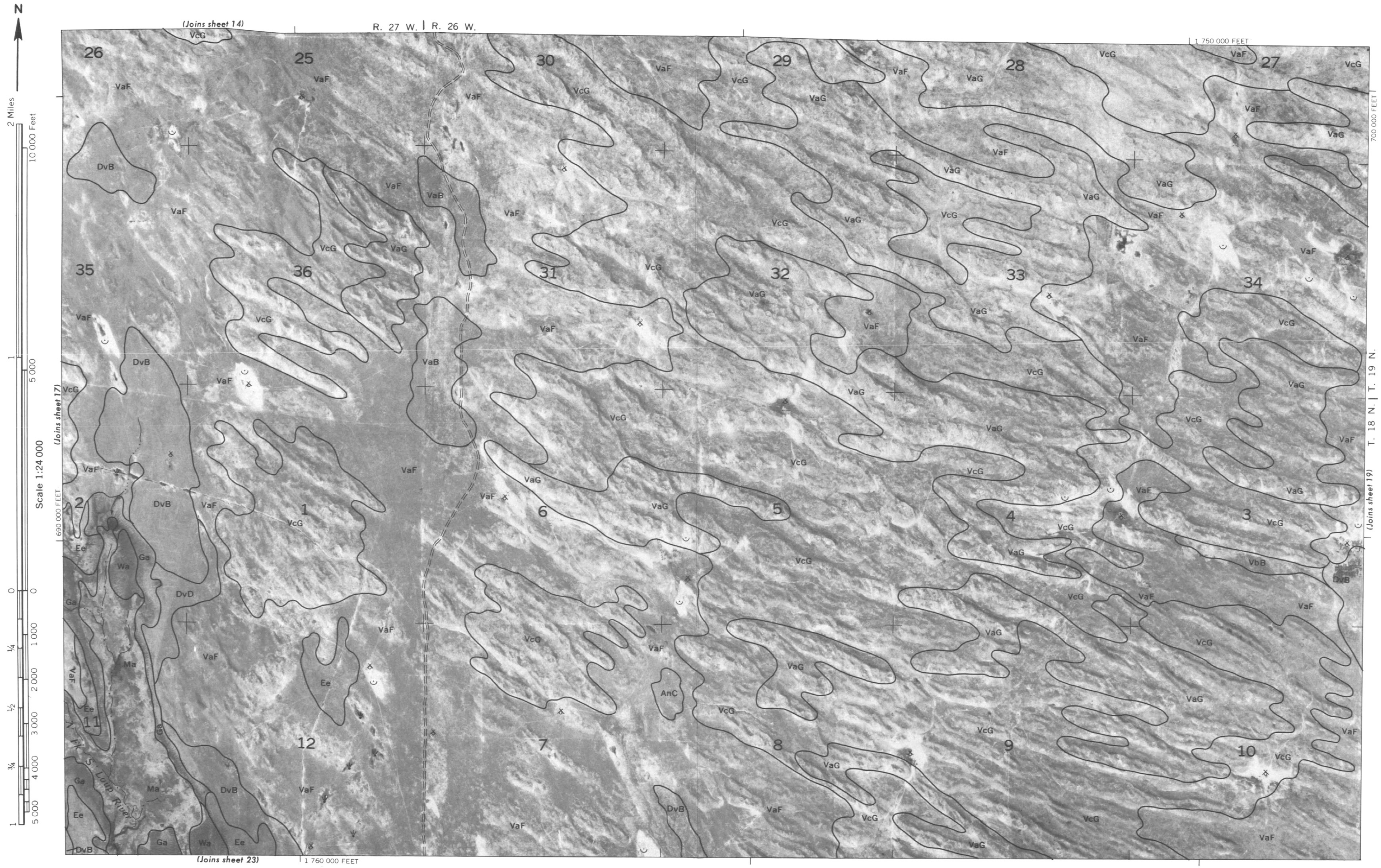
½ 2 000

¾ 3 000

1 4 000

5 000

LOGAN COUNTY, NEBRASKA — SHEET NUMBER 18



LOGAN COUNTY, NEBRASKA NO. 18

Land division corners are approximately positioned on this map.

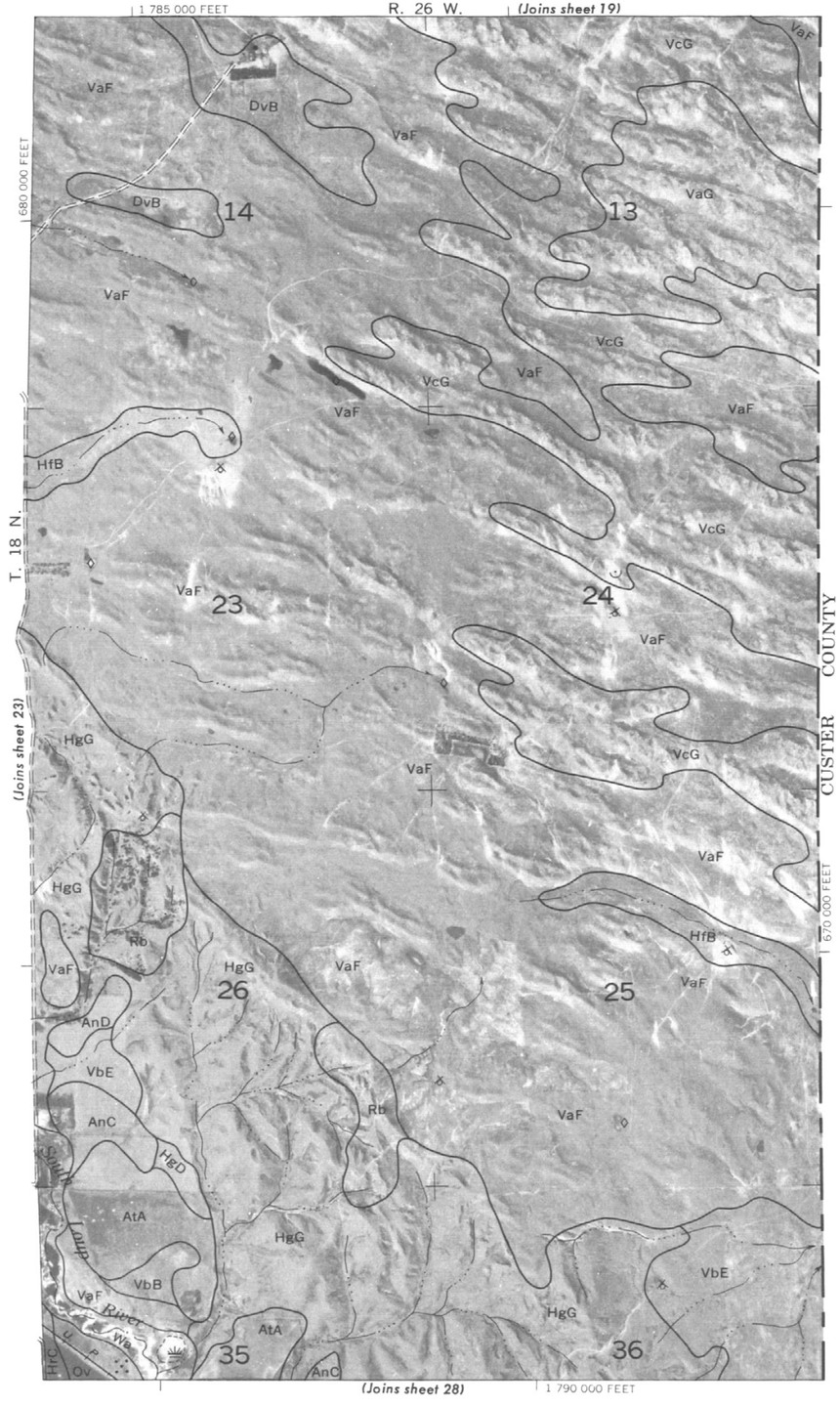
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.

LOGAN COUNTY, NEBRASKA NO. 19

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

5 000 AND 10 000-FOOT GRID TICKS



5 000 AND 10 000-FOOT GRID TICKS

2

N

R. 29 W. | R. 28 W.

THOMAS COUNTY

1 720 000 FEET

(Joins sheet 1)

(Joins sheet 3)

T. 20 N.

1 750 000 FEET

1 740 000 FEET

1 700 000 FEET

(Joins sheet 7)

Scale 1:24 000

2 Miles 10 000 Feet

1 5 000

0 0

¼ 1 000

½ 2 000

¾ 3 000

1 4 000

5 000

LOGAN COUNTY, NEBRASKA NO. 2

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.

LOGAN COUNTY, NEBRASKA — SHEET NUMBER 20

LOGAN COUNTY, NEBRASKA NO. 20

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.

21

N

R. 29 W. | R. 28 W.

1 700 000 FEET

(Joins sheet 16)

680 000 FEET

T. 18 N.

(Joins sheet 20)

(Joins sheet 22)

670 000 FEET

(Joins sheet 25)

1 720 000 FEET

13 18 17 16 15 14

24 19 20 21 22 23

25 30 29 28 27 26

36 31 32 33 34 35

VaF VcG VaG VbE VbB DvB HgG HgD AnC HfB Ga Ma Or Tn Ee Lo Wa AtA

South Loup River

2 Miles

10 000 Feet

1 5 000

Scale 1:24 000

0 1 000 2 000 3 000 4 000 5 000

¼ ½ ¾ 1

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

LOGAN COUNTY, NEBRASKA NO. 21

N

(Joins sheet 17) R. 28 W. | R. 27 W.

1 750 000 FEET

680 000 FEET

T. 18 N.

(Joins sheet 21)

(Joins sheet 23)

670 000 FEET

(Joins sheet 26)

1 730 000 FEET

2 Miles 10 000 Feet

Scale 1:24 000

1 5 000 0

¼ 1 000 0

½ 2 000 3 000

¾ 4 000 5 000

LOGAN COUNTY, NEBRASKA NO. 22

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

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Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

LOGAN COUNTY, NEBRASKA NO. 23

1 760 000 FEET R. 27 W. | R. 26 W.

(Joins sheet 18)

680 000 FEET

T. 18 N.

(Joins sheet 22)

(Joins inset, sheet 19)

1 670 000 FEET

(Joins sheet 27)

1 780 000 FEET

23

N

2 Miles

10 000 Feet

Scale 1:24 000

N

(Joins sheet 20)

R. 29 W.

1 690 000 FEET

660 000 FEET

T. 17 N. | T. 18 N.

(Joins sheet 25)

1 670 000 FEET

(Joins sheet 29)

650 000 FEET

Nesbit

Loup River

South

Scale 1:24 000

2 Miles 10 000 Feet

5 000 0 1 000 2 000 3 000 4 000 5 000

MC PHERSON COUNTY

LOGAN COUNTY, NEBRASKA NO. 24

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

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Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

LOGAN COUNTY, NEBRASKA NO. 25

R. 29 W. | R. 28 W.

1 700 000 FEET

T. 17 N. | T. 18 N.

650 000 FEET

(Joins sheet 21)

(Joins sheet 24)

(Joins sheet 26)

1 720 000 FEET (Joins sheet 30)

Stapleton county seat

UNION PACIFIC

Loup River

Middle Loup

Scale 1:24 000

2 Miles

10 000 Feet

5 000

1 000

2 000

3 000

4 000

5 000

LOGAN COUNTY, NEBRASKA NO. 26

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.

N

1 760 000 FEET | R. 27 W. | R. 26 W.

T. 17 N. | T. 18 N

660 000 FEET

(Joins sheet 23)

(Joins sheet 26)

(Joins sheet 28)

(Joins sheet 32)

1 780 000 FEET

2 Miles

10 000 Feet

5 000

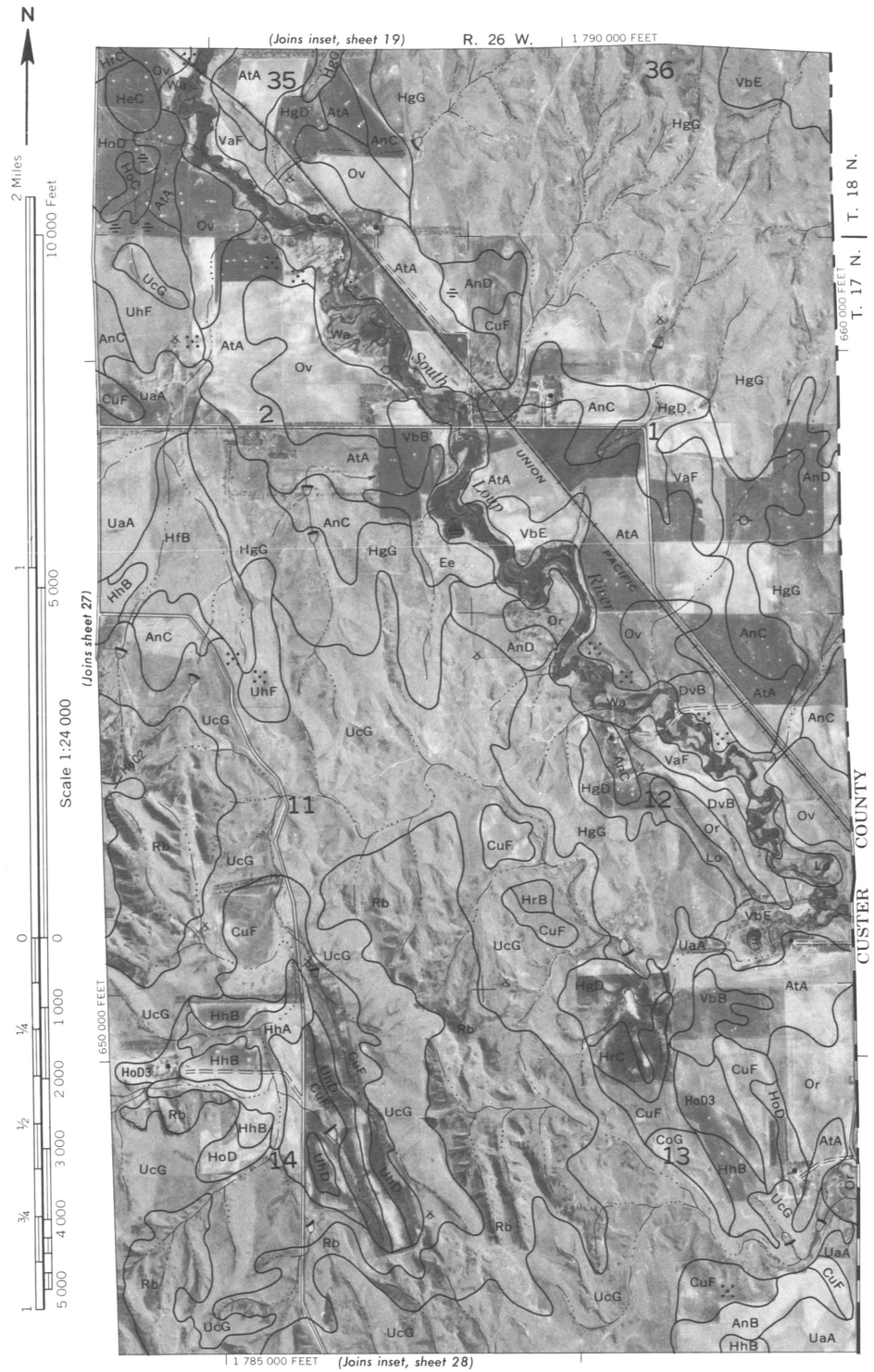
4 000

Scale 1:24 000

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

LOGAN COUNTY, NEBRASKA NO. 27

(28)



LOGAN COUNTY, NEBRASKA NO. 28

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.

LOGAN COUNTY, NEBRASKA NO. 29

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

1 670 000 FEET

R. 29 W.

(Joins sheet 24)

T. 17 N.

640 000 FEET

MC PHERSON COUNTY

LINCOLN COUNTY

630 000 FEET

1 690 000 FEET

(Joins sheet 30)

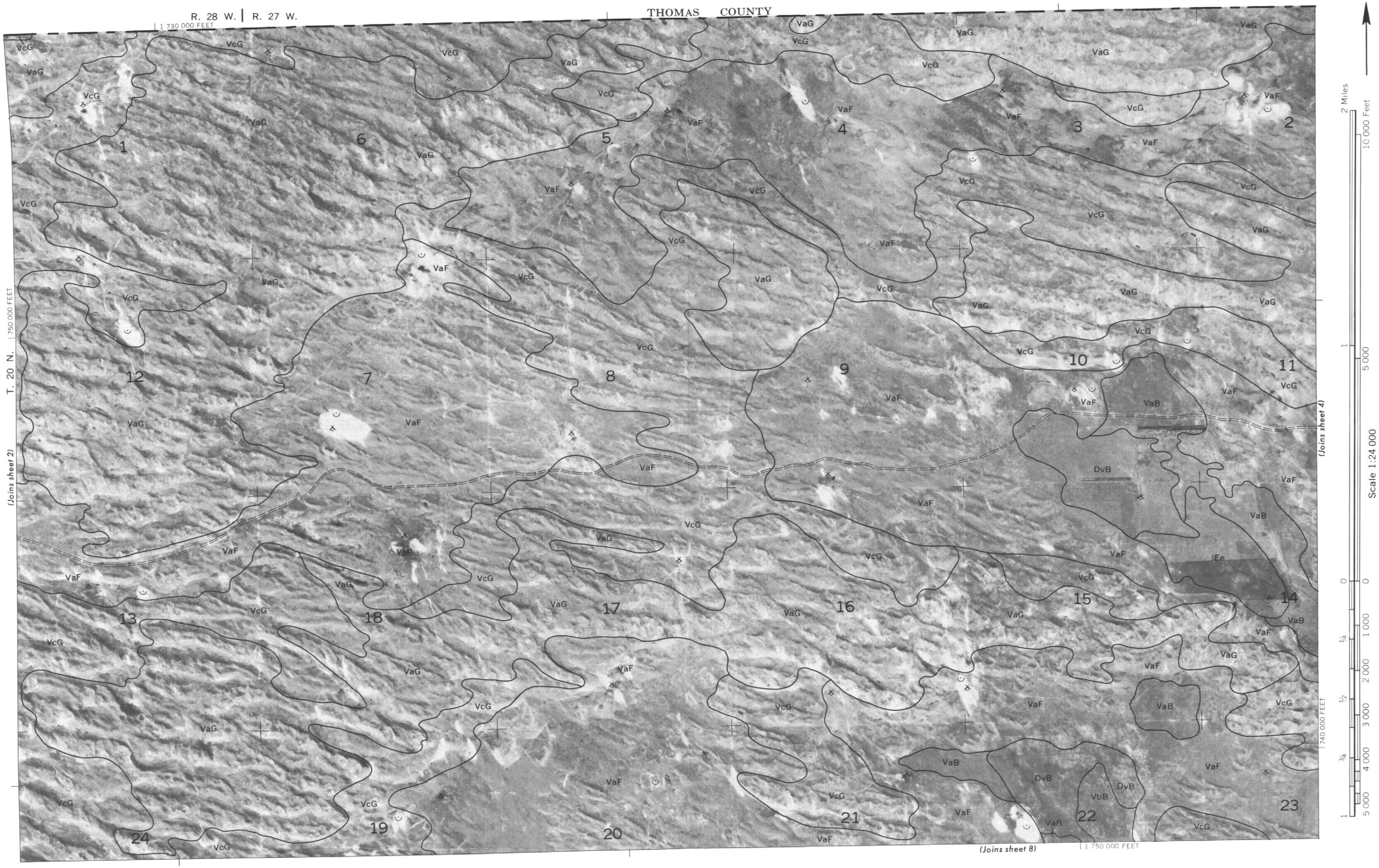
N

2 Miles

10 000 Feet

5 000

Scale 1:24 000



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Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

LOGAN COUNTY, NEBRASKA NO. 3

(30)

N

R. 29 W. | R. 28 W.

(Joins sheet 25)

1 720 000 FEET

T. 17 N.

640 000 FEET

(Joins sheet 29)

(Joins sheet 31)

630 000 FEET

1 700 000 FEET

LINCOLN COUNTY

Sub Station

Dorp

Scale 1:24 000

2 Miles 10 000 Feet

1 5 000 0

¼ 1 000 0

½ 2 000 1 000

¾ 4 000 3 000

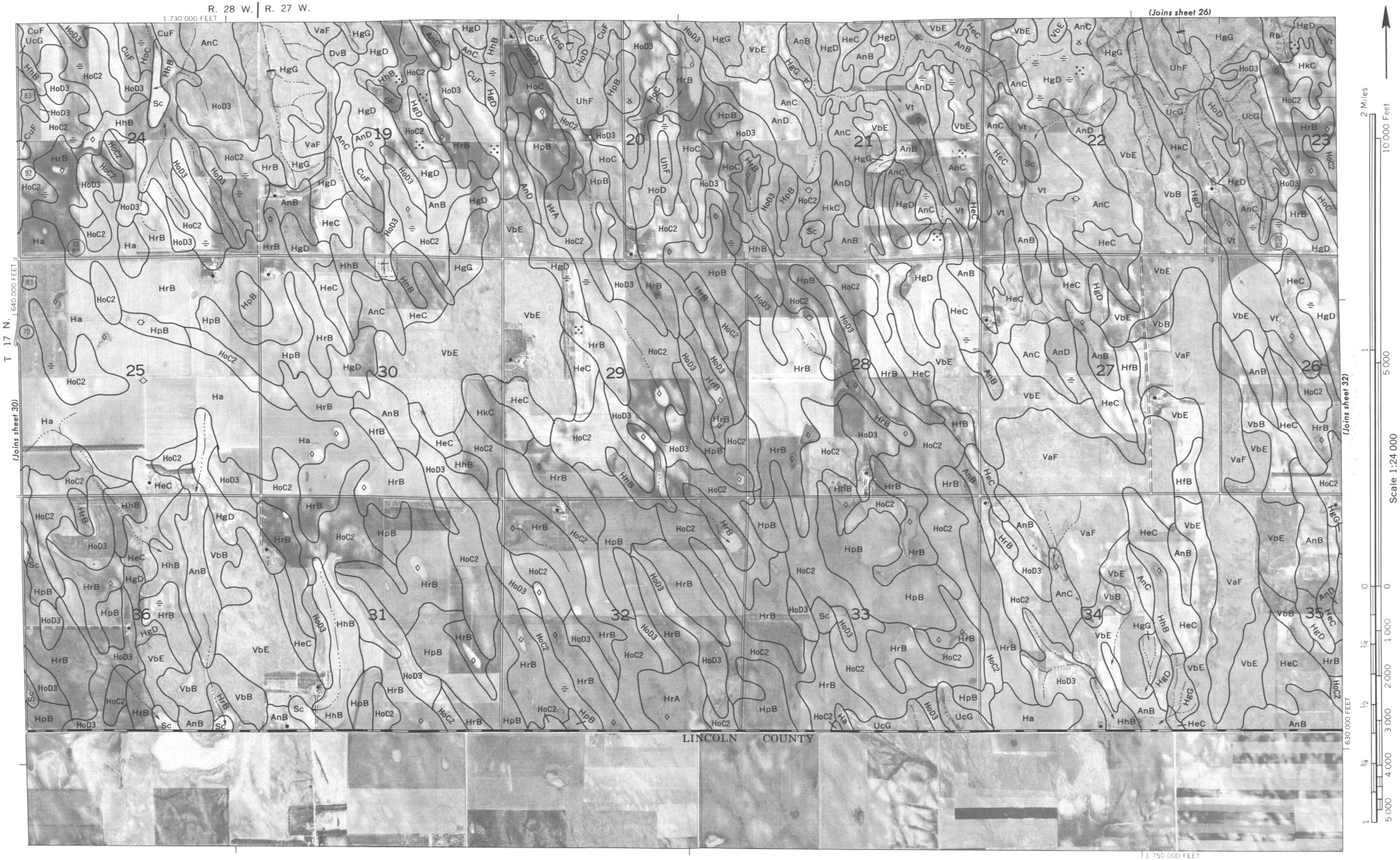
1 5 000 4 000

LOGAN COUNTY, NEBRASKA NO. 30

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.



This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

LOGAN COUNTY, NEBRASKA NO. 32

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.

NEBRASKA NO. 4

LOGAN COUNTY, NEBRASKA

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

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Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

LOGAN COUNTY, NEBRASKA NO. 5

THOMAS COUNTY | 1 790 000 FEET | R. 26 W. | BLAINE COUNTY

T. 20 N. | 750 000 FEET

CUSTER COUNTY

Wild Horse Creek

VaF Ee VcG VaG

1 2 11 12 13 14 23 24

(Joins sheet 4)

(Joins sheet 10)

740 000 FEET | 1 810 000 FEET

5

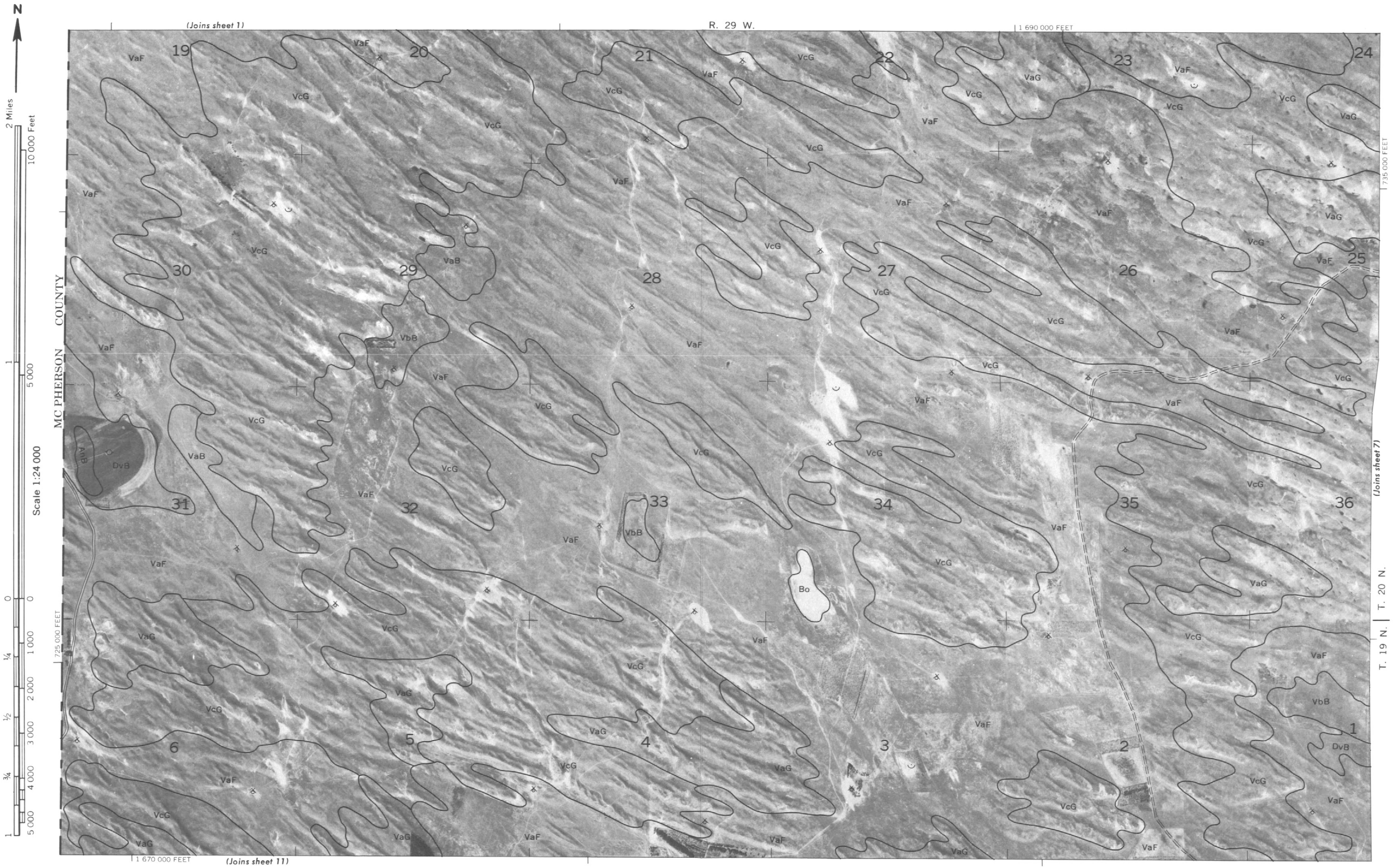
N

2 Miles 1 10 000 Feet

Scale 1:24 000

1 5 000 0 | ¼ 1 000 | ½ 2 000 | ¾ 3 000 | 1 4 000 | 5 000

LOGAN COUNTY, NEBRASKA — SHEET NUMBER 6



LOGAN COUNTY, NEBRASKA NO. 6

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.

N

R. 29 W. | R. 28 W.

1 700 000 FEET

735 000 FEET

T. 20 N. | T. 19 N.

(Joins sheet 2)

(Joins sheet 6)

(Joins sheet 8)

(Joins sheet 12)

1 720 000 FEET

725 000 FEET

2 Miles

10 000 Feet

5 000

4 000

Scale 1:24 000

LOGAN COUNTY, NEBRASKA NO. 7

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the University of Nebraska, Conservation and Survey Division.
Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

N

R. 28 W. | R. 27 W. *(Joins sheet 3)*

1 750 000 FEET

725 000 FEET

1 730 000 FEET

(Joins sheet 7)

(Joins sheet 9)

(Joins sheet 13)

T. 19 N. | T. 20 N.

2 Miles

10 000 Feet

Scale 1:24 000

1 5 000 0

¼ 1 000 0

½ 2 000 1 000

¾ 3 000 2 000

1 4 000 3 000

5 000 4 000

24 19 20 21 22 23

25 30 29 28 27 26

36 31 32 33 34 35

1 6 5 4 3 2

VaF VcG VaG VaB VbB DvB Ee

Mudd Lake

Philpott Lake

Wild Horse Creek

83

LOGAN COUNTY, NEBRASKA NO. 8

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone

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Photobase from 1971 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Nebraska coordinate system, south zone.

LOGAN COUNTY, NEBRASKA NO. 9

1 760 000 FEET

R. 27 W. | R. 26 W.

(Joins sheet 4)

T. 19 N. | T. 20 N.

(Joins sheet 8)

(Joins sheet 10)

(Joins sheet 14)

730 000 FEET

720 000 FEET

1 780 000 FEET

9

N

2 Miles

10 000 Feet

Scale 1:24 000

1 5 000 0 5 000

¼ 1 000 0 1 000

½ 2 000 3 000

¾ 4 000 5 000